SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy JULY 1923 $4.00 a Year

WHEN THE CANAL BARGE TAKES THE ELEVATOR TO SCALE THE HILLS [See page 18]

Scientific American Publishing Co., Munn & Co., New York

THE SCIENTIFIC AMERICAN, July, 1923. Volume 129 Number 1. Published monthly by Scientific American Publishing Company at 233 Broadway New York, N Y and printed in the U S. A. Subscription price, $4.00 per year Entered as second-class matter June 18, 1879, at the post office at New York N Y, under the act of March 3, 1879.

Globe Valve No. 2-B Radiator Valve No. 220

With the Editors

OUR globe-trotting member has been very busy ever since his return, answering questions about his psychic experiences. He has had little time to recall the other aspects of his trip, and everybody has been too busy asking him about the psychic part of his journey to manifest any interest in the ordinary incidents of travel in a foreign land. As he now looks back at these, he finds them far from dull. Many of the impressions which he would otherwise have are submerged in the confused jumble which represents his present recollections of a wild scramble from Paris, through Amsterdam and Berlin and Munich and Zurich and back to Paris again, all in the space of eight days—of which two were spent in Berlin and one in Munich, and the other five, plus one of the nights, on the trains. It will be noted that he entered and left Germany across neutral frontiers.

NOW our globe-trotting member had a "hunch" that this was the way to avoid unpleasantness; and this was confirmed on inquiry at the Bureau of Information in the Gare du Nord, at Paris. In response to his request to be informed on the most convenient and most expeditious way to get to Berlin, he was met by the calm and reiterated statement that "One is not permitted to go to Berlin" He finally got by the attendant, by displaying his American passport in this mad folly of going to Berlin. In Germany they felt the same way about it, every shop or restaurant of any consequence displayed a sign reading, usually, "No service to French or Belgians", or occasionally, the more severe ultimatum "No admission to ."

HE scattered thousand-mark notes with a lavish hand among the porters and taxi-drivers of Germany, then, after exchanging an incredible number of thousands of marks at the bank in Romanshorn for something like eight and a quarter Swiss francs, he tipped the gendarme on the station platform one franc for some very useful information The officer seemed to regard him as a benefactor of the city, but the editor felt like a beggar to descend to such a paltry scale of tipping as a single unit of currency He learned that one can travel for 15 hours, from Berlin to Munich, for 90 cents—or proportionately more if one adopts the second or first class travel which is more fitting for an American millionaire.

THE stamp collector finds the SCIENTIFIC AMERICAN offices quite productive of all kinds of foreign stamps. There is not a day that the editorial mail does not include a sprinkling of foreign stamps. Indeed, the editors keep pretty well informed as to the changes in stamp designs, which seem to be quite frequent during these days of readjustment in many corners of the globe. But cardinal interest centers about those pieces of mail which come from Germany and Austria, whose depreciated currency is reflected by the fantastic denominations of the stamps. Thus the usual letters received from Dr Alfred Gradenwitz, our Berlin correspondent, carry 800 marks' worth of stamps. Yet Dr. Gradenwitz has standardized the size of his photographic prints so that all of them may be placed in those square envelopes so characteristic of Continental letters, together with the manuscript typed on thin paper On the other hand, and in sharp contrast, we receive occasional photographs and accompanying text from a Berlin photographer These come in bulky packages plastered with thousands of marks worth of German stamps, and one cannot help worrying about the expenditure of such big sums of marks for mere postage, until one recalls that a single accepted contribution, when paid for at prevailing rates of exchange, may buy hundreds of thousands of marks. So the situation is not so serious for the contributor as it would appear on the surface.

UNDER the heading "Unprecedented Demand for Old Papers" appearing in the SCIENTIFIC AMERICAN of 75 years ago, we read the following "At the commencement of the present volume of the SCIENTIFIC AMERICAN we had nearly one thousand complete sets of the preceding volume on hand. Since that time we have had five hundred copies of those sets bound, and the balance have been ordered by mail and sent in sheets. We are now obliged to inform our patrons we are unable any longer to furnish complete sets in sheets, and we have but fifty more bound copies left Little wonder that the early bound copies of the SCIENTIFIC AMERICAN are so scarce in our day

AFTER an extensive investigation into the house shortage situation, we have come into possession of considerable first-hand information on that very important question—are present-day houses properly built? Our investigator has gone out on the jobs himself, chatted with the carpenters and masons, called on the lumber companies, consulted building inspectors, and in every other way gathered first hand impressions. It appears that a large proportion of the houses now being constructed throughout the country are being honestly and lastingly built New methods of construction are being introduced to offset the high cost of materials and labor, and many of these new methods have much to commend them It is a mistaken idea that we must forever construct houses as in the days of our forefathers, when lumber was the main material employed and it could be used with a lavish hand because of its low cost On the other hand, there is a good deal of hurried, careless and cheap work going into many houses. Too often the builder, after he has received his payment, does not care how shabby a house will become And the worst feature of the situation is that the average house buyer is quite unfamiliar with building materials and methods and judges his purchase merely by appearances. Obviously it is difficult to unshuffle the bad from the good for by the very nature of a house it is unnecessary purposely to camouflage bad work The walls, when completed, conceal it Our report on the situation will appear next month

AUTOMOBILE statistics at a glance, in the form of simple graphic comparisons, the present state of radio development not only as regards the broadcasting situation but more particularly the development of radio receiving equipment diamond mining in Colombia the application of carrier current communication to the broadcasting of music and talks over telephone lines and electric transmission systems, the magnitude of the canning industry with special reference to fruits and vegetables—these are but a few of the features of our forthcoming August issue which, we hope, will be more varied and more interesting than ever

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SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

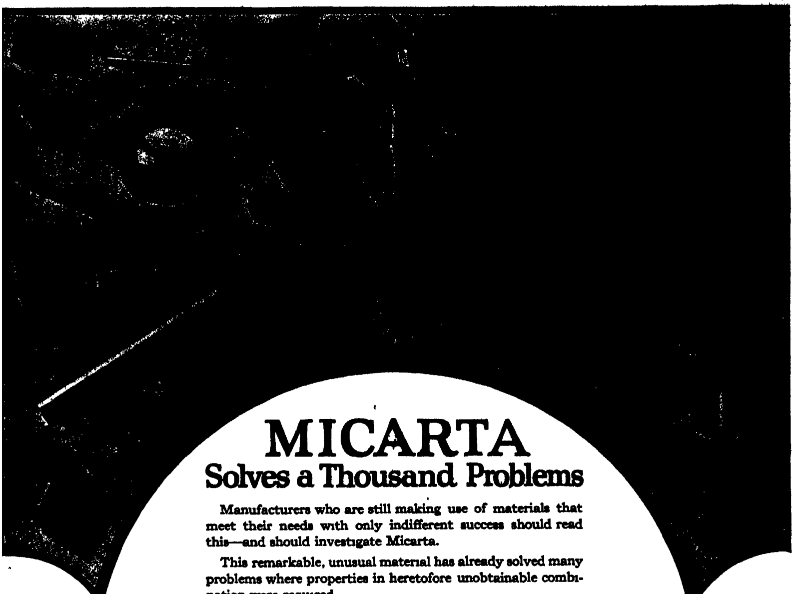
Founded 1845

CHARLES ALLEN MUNN, President ORSON D MUNN Treasurer

ALLAN C. HOFFMAN, Secretary

Vol. 129, No. 1 Published monthly. Entered as second class matter June 18, 1879 at the post office at New York, N. Y., under the Act of March 3 1879

Price, 35 cents a copy; $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5 00 a year postage prepaid.

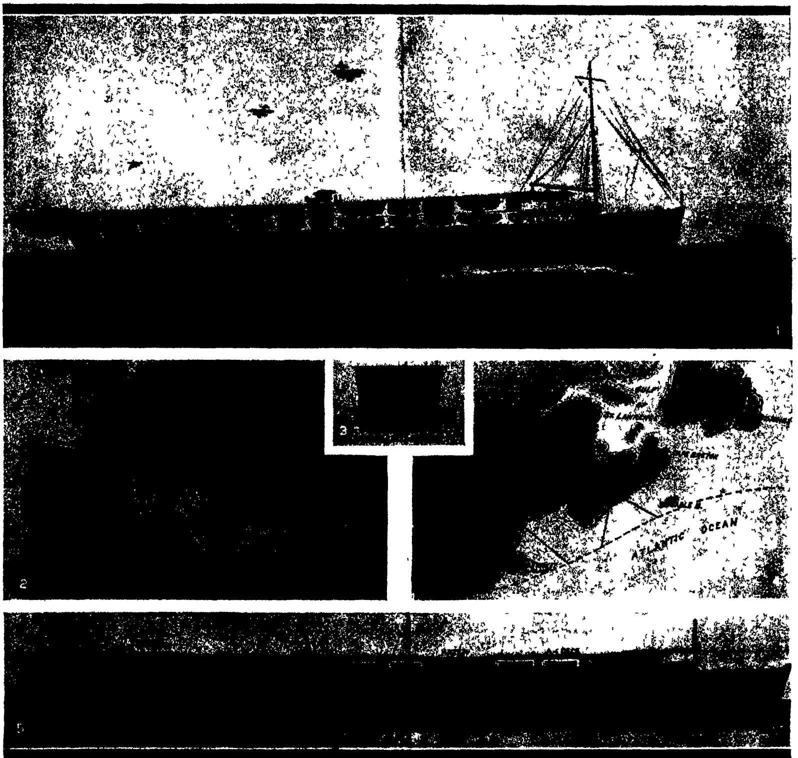


SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JULY, 1923



1. Proposed aircraft-carrying mail steamer in mid-Atlantic. 2. Land's End to Sable, showing by dotted line the track of steamer, by full lines the airplane tracks to and from landing places. 3. Midship section; note the bulges for stability and steadiness. 4. Chart of north-eastern Atlantic seaboard, with steamer and airplane tracks. 5. Longitudinal section showing flying deck, passenger accommodations, airplane hangars, engine and boiler rooms with smoke ducts discharging astern

Ocean travel by combined steamship and airplane [see page 16 for description]

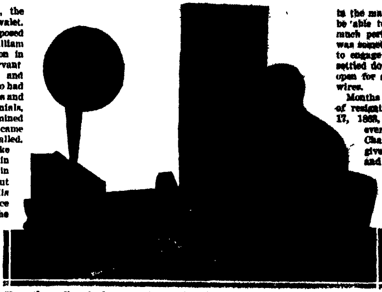
Trapping the Burglar

Clever Devices Put Forward by Inventive Genius for Catching the Prowler at His Work

By Edward H. Smith

EARLY in 1868, His Highness, the Duke of Brunswick, hired a valet. As was his custom, the deposed Charles Frederick Augustus William exercised both care and caution in the choice of this new body servant He spent many weeks over the problem and finally settled upon one, Shaw, a Britisher who had apparently served several noble English houses and come away with the most glowing testimonials, all of which the ducal German had examined with anxious eyes. Shaw arrived in April, came to terms with his new master and was installed.

The circumspection with which the duke moved was natural On his dethronement in 1830, he had removed to a great old house in Paris, carrying with him a treasure of about three million dollars in jewels and gold His collection was famous and the refugee prince understood that he and his hoard were the objectives of constant plots among European crooks. Accordingly, his Paris house was most strangely and marvelously fitted with defenses in the nature of special locks and bolts, iron doors, watchmen and alarm contrivances. Every European inventor of new kinds of anti-burglar devices found a ready customer in the duke, and certainly no house on the continent could show curious and ingenious defenses to match those to be found in the ducal quarters.



Even the radio telephone has been enlisted in running down the thief. Here is how the New York Police Department broadcasts an alarm to everybody

The store of jewels was kept in a huge iron safe of French or German manufacture, which stood in a specially constructed alcove opening from the ducal bedroom—a retreat which might now be called a vault. This alcove was closed with a heavy iron door fitted with padlocks of intricate design Once this door was got open, there stood the vast safe, again locked with a series of contrivances and—what is of particular interest here—defended by not one but three set-gun arrangements. If any rash robber attempted to open the door of the safe without the proper keys and the secret of handling them so as not to release the triggers, he was certain to receive the fire of these formidable batteries of revolvers and slug guns—enough to dispatch an elephant

No one but the duke himself had the keys and only he understood the complete intricacies of his defenses. As a rule, he permitted no one else to be present in his bedroom when he opened the doors of the vault and safe, as he did at intervals, either to gloat over his treasures with miserly emotion or to display some of his gems to friends or to an autumnal inamorata.

Such precautions had succeeded for more than 30 years. There had been plots and attempts without number, including one abortive attack on the duke's life, which he interpreted as an effort to get at his possessions. Now, however, he had himself opened the way to his hoard. Shaw, the new valet, was a notable British professional burglar His references had all been forged and the hyper-cautious Brunswick prince had fallen before a trick which still succeeds in putting criminals into the households of the rich

Shaw put in the first few months of his service getting the confidence of his master, a thing not too lightly accomplished But once the fugitive princeling had been well beguiled, he trusted Shaw even to the extent of admitting that he actually owned some jewelry and that it was somewhere about the house. The servant had, to be sure, discovered the iron door of the vault on his first day in the house, obviously hidden as it was behind heavy velvet portieres near the head of the bed.

The new valet seized the first opportunity for examination. When his master had gone out and the other servants were elsewhere, he drew aside the portieres and inspected the locks of the vault door. Two of them, he saw, could be picked without great difficulty The other was of a well known make and he consequently anticipated ease in procuring its key through confederates. This job was shortly accomplished, and the next time the duke left the house his valet promptly opened the vault door and beheld the fearsome aspect of the safe. Not only was it protected by the batteries of shooting irons, he found to his surprise, but it was electrically wired, surely the first strong-box in Europe to be so equipped.

This wiring was mere child's play compared to modern installations of the type. It is, however, for more than one reason, worth attention. The electric wires on the duke's safe led to bells in various parts of the house, which would begin to clamor the moment any one tried to force the safe door or tamper with its locks. This was a revolutionary idea and the only part of the duke's defenses with which the burglar had not been familiar from the beginning.

Just how far beyond the imagination of men the electric bell was at this time may be seen from the experiences of Mr Edwin Holmes, the originator of the well known central office burglar alarm system which bears his name. Holmes's device was originally no more than a mechanism by which an alarm bell was sounded in the bedroom of the user or in some other part of the house distant from the door or window being attacked by the burglar Only a few years before the episode of the Duke of Brunswick, Mr Holmes had been forced to go about in Boston and New York with

A home-made set-gun for garage use, which would probably put a [illegible] upon the burglar's career

a miniature model of his installation, in order to prove that disturbing a switch at one point could set off a bell situated elsewhere. No one would believe him without being shown.

Evidently some French electrician had achieved similar results a little later than the American inventor and probably independently His device had been installed by the duke.

Mr Shaw, valet and burglar, reclosed the door of the duke's vault with a sense of defeat. He could get to the safe door, right enough. Also, he was an expert in the matter of set-gun mechanisms and had hoped to be able to disconnect those of the duke without too much peril and trouble. But this new electric thing was something he had never experienced and was loath to engage However, he did not despair. Instead he settled down to watch developments and keep his eyes open for a chance to discover the secret of the duke's wires.

Months passed without result and Shaw was thinking of resigning and returning to London. On December 17, 1868, however, the unexpected carelessness of every man played into his hands. The cautious Charles Frederick Augustus, etc., had decided to give a certain lady a few jewels for Christmas and had summoned a jeweller to consult with him about putting the gems into fresh settings. Preparatory to the goldsmith's arrival, the duke opened his vault and the door of the safe. Then he sat about, chafing and waiting. An accident had befallen the jeweller and he did not appear After fuming for an hour, the duke impatiently closed and locked the vault door without having taken the trouble to reclose the door of the safe and put his set-guns and alarms into business order So he quit the house, leaving a caustic message for the jeweller who was to be commanded to return that evening.

Shaw, of course, seized the golden opportunity, opened the locks of the vault door, filled his pockets with what seemed most readily salable of the duke's treasures and fled. But he was indiscreet enough to write letters and happily was arrested at Boulogne with the duke's diamonds in his pockets.

I choose the tale of His Highness of Brunswick to open this account of mechanisms by which men have sought to catch burglars because it reflects the transition from primitive arrangements of this sort to modern appliances. The set-guns with which he had rigged his safe were almost as old a contrivance as firearms themselves, the electric wires were and are as modern as anything save the wireless.

In this generation we hardly think of a burglar alarm or thief trap without electricity Once men could not imagine such devices as made effective save by means of gunpowder. But the man trap is, of course, much older than either electricity or explosives. Primitive African tribes use pitfalls and snares against their enemies in battle and against invasion by thieves of their villages and cultivated lands. No doubt, such tricks were first employed back in paleolithic times in hunting game. We find the modern applications of these savage ideas in pitfalls which have been employed against poachers in Europe and in this country within memory

In the days of Louis XIV of France, one of the royal safes was equipped with a bomb, arranged to explode in case the strong-box were forced open. Unhappily it blew up a trusted servant instead of a burglar Accidents of this sort have gradually discouraged the use of the set-gun, which used to be primed behind the door of many an humble chicken coop and goods cellar. I recall such an incident from my own boyhood. A farmer in the vicinity had repeatedly been robbed by hog thieves and decided to end the depredations by means of a loaded shotgun set up in his stable and pointed at the door, whereto it was attached by a cord, which pulled the trigger when the door was pushed open. The farmer himself forgot what he had done and [illegible] the loss of a leg. [illegible] discouraged the employment of these [illegible] mechanisms [illegible] [illegible]

early dynasts of Egypt were probably as much concerned with thieves as with the durability of their monumental labors. Khufu probably built his pyramid with an eye to the main consideration of protecting his trimillennial sleep and the treasures of his funeral vault against intrusive burglars—and failed. The rock-hewn tombs of later kings, now so much discussed, give the evidence of this, for they were not monuments at all but safes of stone, built to deceive and defy robbers. And witness the irony that only the crypt of the worthless Tutankhamen escaped, while all about him the two-legged jackals murdered the sleep and spoiled the reliquaries of illustrious great Pharaohs.

As civilization advanced and knowledge of new principles and forces came to men, all in turn were applied to the problem of defeating the thief—particularly the burglar. Every mechanical system has been used for this purpose. In its day steam was applied to the task. Explosives and electricity have already been mentioned. It is a fact, as witnessed by various applications to the patent office, that inventors are busy today at wireless alarm systems.

The pervasiveness of this problem in the minds of inventors of every period is only parallelled by the persistence of the robber. Any man possessing the divine patience to run through the gazette of patents for the last 30 years, let us say, would be appalled by the number and variety of anti-burglar devices. He would be convulsed with laughter at many of the listed devices and stunned by the ingenuity and intricacy of many others. A few samples will reveal enough.

Some years ago an inventor invaded the office of one of the largest burglar alarm companies and presented his invention. It was a gilded or nickelled affair of metal, very like a hunting-case watch and designed to be hung on a chain and slipped into the vest pocket opposite that containing the watch, both the timepiece and this mechanism being attached to the same chain at opposite ends. Inside this metal contraption was a small blank cartridge held against a plunger and trigger arrangement. If a pickpocket took hold of the chain and tried to lift the watch, off went the cartridge with a loud bang. Being enclosed in the metal case the exploding powder was not expected to set the user ablaze, but one wonders what might have happened to the nervous gentleman who reached into the wrong pocket for his watch, or what riots might have happened on crowded subway trains when some "dip" got to work.

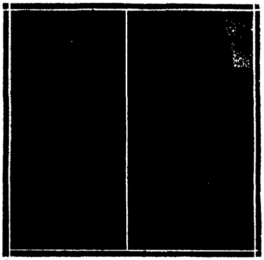
Another inventor developed a little mechanism based on the cap firing sticks used by children on the Fourth of July, with the difference that his cap shooter used a spring and trigger firer. A cord was run from the door knob to one end of the little device. Another cord connected the off end of the cap firer with the wall. If anyone opened the door there was an explosion sufficient to frighten away any burglar ignorant enough not to know about the toy.

When I was much younger an inventor in the Middle West persuaded a local banker that he was in great danger of being robbed by hold up men, with the result that a number of special trap doors were cut into the floor of the bank just before the tellers' cages. If a hold-up man entered the teller merely touched a button and the floor yawned beneath the robber, letting him down into a basement, where he could be captured at leisure. Unhappily, the mechanism went awry one busy Saturday morning with the dire result that four valued depositors scooted into the oubliette, one of them sustaining a broken leg and another some sore bruises. Damage suits and the immediate removal of this invention resulted.

Within the memory of most of us, the principle of the electric chair was experimentally applied to the safeguarding of safes and vaults. Someone thought up the idea of placing metal mats all about safes and then attaching both these mats and the safe itself to a high voltage electric light circuit. Woe unto the burglar who trod upon those mats and touched that safe. Such an arrangement might have served well enough were it not for the trifling obstacles of the law and human fallibility. There happens to be no authority in the books for the private electrocution of safe crackers, and bank employees will forget to turn off the switches controlling such terrific mechanisms just as they will neglect to close windows and enter checks. This was, in fact, what happened in a small bank where this rash plan was tried. Fortunately the current was not strong enough to kill the forgetful cashier.

Another extremely deadly set gun of the sawed off shotgun type

To go into the matter of the alarms which have been devised to keep thieves and burglars out of private houses and apartments would be to write a catalogue. Catches on doors and windows which set off gongs by mechanical means are perhaps the commonest. Every inventive boy has fitted his father's house with something of the sort. Strings and cords stretched across rooms and apertures at night for the fumbling feet and hands of the burglar in the dark have been almost as numerous. When touched by an intruder such lines released a trigger or pulled out an electric plug, thereby setting a gong into violent agitation. This idea is still applied to some types of local gong alarms used in New York City. Devices for relocking windows and doors, cartridge exploders, rocket firers, whistle blowers, electrified common screens for summer use when windows are open, and many others needs to be noted. Years ago I saw a house equipped with an automatic lamp lighting system. All the gas jets were rigged with pilot flames which burned very dimly all night. If any burglar opened a door or lifted a window the chains of the lamps were pulled by a mechanical contraption of wires and pulleys, with the result that the lights flared up. Later I saw this idea adapted to electric lighting.



Inside and outside views of a pocket equipped with the latest device for keeping out the prying pickpocket's fingers. The owner of the pocket gets in by pulling the string latch, as shown at the left

The weaknesses of all these plans are at once apparent to whoever has given the burglary question even desultory attention. Either the mechanisms are more perilous to the user than to the criminal or they are so readily defeated by any informed burglar as to render them worse than useless. As a result of the defects which appear in all alarm systems and in all else that is human, there has been a constant quest for the unbeatable alarm — a cry after perfection.

Needless to say, the impossible is achieved every little while in the fevered brain of some infatuated designer. Not long ago an inventor approached the officials of a prominent alarm company with the modest statement that he had it at last. On investigation his invention proved to be a device attachable to telephones which would jiggle the receiver hook up and down rapidly in case any window or door lock were disturbed in the night, thus flashing to the central operator the message that a burglar was on the premises. All the hello girl had to do was to summon the police. Was this not simplicity and effectiveness to the point of purest beauty? It was—until the alarm man asked his friend what would happen if a burglar cut the wires.

Another and more dramatic incident of this sort happened to the same official. A very earnest young man came in with a burglar alarm device of which the central instrument was a series of glass tubes, almost filled with liquid, in which floated a cork transfixed by a copper wire. Electrical contacts were placed at the top and bottom of each tube. If the tubes or any one of them were broken the liquid ran out and the cork fell to the bottom, completing the circuit by means of its bit of copper wire and off went the alarm. If, on the other hand, the place took fire, the heat of the room would sufficiently expand the liquid to raise the cork to the top of the tube, again closing the circuit and giving the alarm.

"You see," said the young man, "I've certainly got it. There's no way to beat it. Is there?"

He stared at the alarm company's officer with defiance in his eye.

"Not unless you cut the wire," said the other.

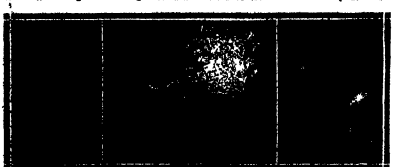
The inventor stiffened like a man shot, rose out of his chair, stood upright for a moment and then collapsed in a dead faint. When he had been revived he took his invention, tossed it contemptuously into his satchel and went away without a word. Zeal had betrayed him.

I have spoken above of the persistent use of explosives in burglar catching devices. The farmer's gun in the hen coop is, as indicated, far from obsolete, but inventors have lately been offering through the regular market a specially designed mechanism for the shooting down of nocturnal invaders. This consists of a simple mounting to be screwed to a desk, table, window seat or shelf. To this is attached a short shotgun barrel of eight or ten inches in length, designed to receive an ordinary 12 gage shell. Behind the barrel is a spring trigger arrangement which is to be attached to a wire stretched across the room and fastened either to a door or window or to the opposite wall, the wire being drawn taut. The barrel of the gun is then aimed along the wire. If anyone, by opening a door or window, pulls on it during the night, or if an intruder stumbles against the wire in the dark, he is directly in the line of fire and certain to receive the charge of shot. Such a mechanism is effective, of course, only when the burglar is ignorant of its presence. Its deadly nature will probably persuade many against it.

Set guns have nevertheless played a dramatic part in the stories of many an American community, as witness the case of Charles Adams of Chester, Vermont. A number of years ago this quiet little community suffered from what the reporters love to call an epidemic of burglaries. Shops, factories, private houses and even stables were entered at night and everything was stolen, from a hen or bag of feed to half a merchant's stock of clothing. The local police and the irate citizens tried every manner of dodge but caught no one of importance. When special vigils were being kept or definite plans operated for the apprehension of the burglars no places were robbed. But as soon as the vigilance was relaxed and the town began to make up its mind that the robbers had passed on to some other community—well, there were fresh burglaries. It seemed that some one in the deepest confidence of the local officials must be directing the criminals.

One of the chief figures in the town's fight against its plague of intrusions was this man, Adams. He was head of the board of education, supervisor of the public library, ex-legislator, a bookish and studious man, an old resident descended from locally distinguished ancestors and prosperous if not wealthy. He supplied the local vigilantes with more ingenious plans for thief catching than anyone else in the town, but the actual

(Continued on page 69)



[illegible] gas bomb, attached to door (right) or window (left), and tripped by an effort to open, as shown in the center

Building the World's Largest Monolith

A Word Regarding the Far-Reaching Significance of Wilson Dam to Navigation and Industry

By Luttell McClung

THE MOST significant effort in construction undertaken by the Government since building the Panama Canal is the monolithic fashioning of Wilson Dam across the Tennessee River at the foot of Muscle Shoals in northwest Alabama. Under direction of War Department engineers forces of men many of whom are trained in dam building are pushing the work night and day on this the largest concrete form in the world. Wilson Dam will be not only the most massive structure of its kind but it will be the greatest hydro-electric installation yet achieved.

The photographs reproduced herewith are the first showing the progress of the Government's effort. At present work is in five main divisions. First there are the lock chambers for navigation over the dam at the north end. Just beyond these rises the short non overflow section. Across the two channels of the river and the island between them extends the main spillway division. At the south end against high banks stands the half finished powerhouse on which construction is rapidly going forward. Then driven into the south banks for a quarter of a mile will be the high core wall.

The two locks along the north side will have a lift of 45 feet 6 inches each. These locks like all the other equipment on Wilson Dam will be electrically operated by current from the generators. Some idea of their massiveness may be gained from the fact that the lock gates will weigh 1500 tons and each of the 63 crest gates will weigh 34 tons. Orders will soon be placed with large manufacturers for some of this machinery for which Congress recently appropriated $10 000 000. This cost is in addition to that for turbines generators and much of the other electrical equipment. When completed Wilson Dam will be 5000 feet long 101 feet wide at foundations and will lift its superstructure nearly 125 feet above the river bed. To bring into existence such a monolith in a river where the flow sometimes reaches 500 000 cubic feet a second all phases of the work must be synchronized—drilling blasting and excavating bringing in materials for making concrete building flawless forms transporting concrete to these forms and the final pouring. To consolidate these factors in a continuous manner requires 27 miles of railroad two dozen boats and barges a number of electrical cranes scores of rock drills three huge crushing and mixing plants 80 locomotives and more than 200 cars and gondolas.

Smooth and beautiful work on the main spillway section, showing the special piers that will carry the illuminated boulevard along the top of the Wilson Dam

The effort is truly gigantic and in some phases quite spectacular both as to engineering and construction. This may be realized when one considers that Wilson Dam will contain almost three times as much masonry as the Roosevelt Dam in Arizona and that it will be 81 000 cubic yards larger than the Assouan Dam in Egypt—at present the giant among the world's river barriers.

There are few precedents to guide the various phases of the work for the reason that this is the most massive dam ever undertaken and because it is being built in a limestone country where fissures may occur in the rock strata. While the general principles of gravity-dam construction are well known Wilson Dam, like the Panama Canal is a problem unto itself and in an engineering sense a fascinating one.

The first natural enemy to be checkmated is upward pressure—the upward thrust of any water that may seep under the foundations. At the start, of course, the riverbed was exhaustively tested by diamond drilling and hydraulic pressure. Then the solid rock was blasted out 16 feet deep across the stream. Into this channel the concrete foundations of the dam were "toed" making them virtually monolithic with the natural rock.

Throughout the length of the dam a tunnel is being constructed through the foundations close to the riverbed. From this tunnel 6-inch holes are drilled far down into the limestone beneath. There is one of these every 28 feet from bank to bank of the river. If upward pressure occurs from seepage these holes will act as relief valves, taking up the water and releasing it through pipes into the river below. And through them concrete will be shot down and driven under air pressure into any crevices through the rock, thus permanently sealing them.

Some of the most interesting work is that on the great powerhouse that will be 1184 feet long. The day the accompanying photographs were taken, workmen were busy tearing out the forms and revealing the outlets of the first penstocks. The volumes of water that will surge through these penstocks to the turbines may be envisioned when one realizes that each penstock is 12 feet 4 inches wide and 15 feet 10 inches high. There will be 54 of these—three to each turbine—and they will have a capacity of 62,000 cubic feet of water per second.

Four of the 18 turbines will have a generating capacity of 30 000 horsepower each. The other 14 will develop 86,000 horsepower each. The total maximum installation will be for 624 000 horsepower. And this energy harnessed from the river's flow and pressure will be supplemented by the 100 000 horsepower steam plant built by the Government that stands on the banks of the river a mile below the dam.

A fine problem in engineering and construction is presented in cementing the powerhouse forever into the limestone bluffs by means of a great core wall 1500 feet long. This core wall will be as high as the dam itself seven feet thick at the base and will taper to five feet at the top. This immense, invisible water barrier, deep down in the rock under the earth will for all time prevent any possible seepage around the power house end of the dam.

Before Wilson Dam is finished almost 1,000,000 yards of earth and stone will have been excavated from banks and river bed and 1,260,000 yards of concrete will have been poured. The work is under immediate direction of Colonel W J Barden, of the United States Army, and Government engineers associated with him. There will be no letup night or day until the project is completed at a cost of approximately $50,000,000.

A race with Nature is immediately ahead in building across the swift south channel a very high cofferdam nearly 700 feet long. As this article is written the engineers are concentrating every possible force on this cofferdam. Their determination is to have it finished by late summer as summer and autumn constitute the low-water period in the Tennessee Valley. If this last cofferdam is completed on schedule, entirely diverting the south channel during low water, then the dam's foundations can here be blasted out and concrete pouring will raise this section of the structure to sufficient height for work to continue on it steadily through the high water period of next winter.

A bascule bridge spanning the locks at the north end, will join a concrete arch bridge over the main structure and by the power house. These bridges will have a boulevard surface and will carry double tracks for electric cars. The boulevard will be a link in three national highways—the Jackson Highway, from Chicago to New Orleans, the Lee Highway from the Eastern Seaboard to the Pacific Coast and the Scenic Highway, from Jacksonville, Florida to Seattle, Washington.

Here and there the removal of the wood forms indicates the striking beauty and perfect uniformity of the work. When finished, Wilson Dam will be one of the most beautiful structures in America. Owing to the depth of the power pool, the waters flowing over the crest will be clear. A magnificent system of lighting will be installed and the boulevard will be swept with evenly distributed rays from reflectors sunken along the parapet. In the river below the dam especially built searchlights will be anchored. These fans of illumination will flood with brilliance the sheet waters flowing over crest and apron and the volume of tumultuous tail waters foaming out from the turbines. The idea back of this spectacular illumination is that the dam, being a link in three highways across the United States will be visited annually by thousands of tourists and should be a creation of shining beauty as well as a generator of vast power.

In the coming great effort to make our swifter inland waters navigable Wilson Dam is most significant. Industrial America is just beginning to catch a glimpse of the tremendous significance of navigation on mountain streams. Low-banked, slow moving rivers like the lower reaches of the Ohio and Mississippi do not carry boats and barges up into the heart of mineral resources. But their high tributaries and the other swift flowing streams have cut their channels through the great iron and coal measures of the Appalachians. There are a number of such streams throughout the Eastern and Southern States. Of these, perhaps the most important is the Tennessee, with its tributaries uncovering the rich mineral regions of east Tennessee, western North Carolina, northern Georgia and northern Alabama.

As to navigation—to say nothing of power—Wilson Dam marks a definite change of policy after a century of open-channel work, with canals, on our swifter rivers. It is almost a certainty that in the future navigation and power dams with electrically operated locks will completely displace counter-current navigation through open channels and canals along power rivers flowing through regions of vast mineral resources.

Apart by itself Wilson Dam is not a power-and-navigation unit. It is only the most important factor in the first comprehensive system of river improvement undertaken on the North American continent. This system includes plans for building power and navigation dams for nearly 400 miles up the Tennessee River—throughout the entire distance between Muscle Shoals and Knoxville.

Several of the larger tributaries already are under development by means of very high dams, and Government engineers have just started a regional power-and-mineral survey that will cost $600,000. The cost of the

development itself will run into hundreds of millions of dollars. But whatever financing the Government does on this will be returned to the Government by the companies and corporations that lease and use the power. These staggering expenditures will not come out of the pockets of the people. They will be far more than returned. They will be multiplied by the vast wealth they smelt from the minerals by hydro-power through the electric furnace. And these dams will literally make navigation a perpetual by-product of hydro-power. The significance of this is almost beyond present-day vision

The lower stretches of the development in the Tennessee Basin are fully under way Between the foot of Muscle Shoals and Chattanooga there will be 11 concrete dams, with locks—three of them power dams. The largest of these, Wilson Dam, is more than half finished. Fifteen miles above—at the termination of the power-and-navigation pool—will be another power generator which will be 40 feet high. Its pool will be 60 miles long.

The next five dams will be for navigation alone and will range in height from eight to eleven feet Work is in progress on one of these and the survey for another has been made. Then, 33 miles below Chattanooga, is the Hale's Bar power dam that has been in operation for several years.

In the manufacturing field Wilson Dam is highly significant because it is in the midst of one of the richest and most diversified mineral regions in the world. Fifty miles directly north are the second largest phosphate rock deposits in America. Within less than 100 miles south are the Warrior coal fields—the most extensive and productive in the entire South Both north and south and northeast up the river are brown hematite ores beyond present computation. There is virtually limitless material on which to use the river's power through the electric furnace. And, incidentally, the greatest system of electric furnaces in the world is ready for operation in the huge air-nitrates plant just below Wilson Dam, a description of whose processes appeared in the May issue of this journal.

The variation between the primary and secondary power of Wilson Dam cannot now be determined. It depends upon whether or not storage dams are built to conserve the flood waters of winter for power uses during the summer It is stated that if the Government leases the project to Mr Henry Ford, he will build immense storage basins on two tributaries of the Tennessee—the Clinch and Powell rivers. These streams, the contours indicate, can be converted into storage basins by the building on them of very high, but quite narrow, concrete dams.

The next Congress will make final disposition of the Muscle Shoals project and properties, and perhaps quickly. While many ideas have been suggested and advanced, the only definite plan actually before Congress is that of Mr Ford. It includes returning to the Government, with interest, all the cost of Wilson Dam and the second great power dam 15 miles east; paying the Government \$5,000,000 cash in addition and taking over the plants and properties, and agreeing to manufacture complete fertilizers and selling them to the farmers at not more than 8 per cent above the cost of manufacture.

The first of fifty-four penstocks—three to each of the eighteen turbines. One of the huge turbine seats is shown in wood forms at the right

World Metric Standardization

IF we are to believe the very logical arguments of the World Metric Standardization Council as expressed in a rather voluminous work entitled "World Metric Standardization," there exists no good reason at all why the meter-liter-gram system has not been adopted by the people of the United States and Great Britain, except that deep-seated quality of human nature which causes us all to put our backs up and resist changes until they are forced upon us. This book contains over five hundred pages of reasons, both argumentative and testimonial, favoring the adoption of this system, but it would not seem necessary to read beyond the opening chapter in order to become convinced that the arguments are rational, and that the metric system is a sound one and would be a most desirable thing—a generation or two after it had been adopted.

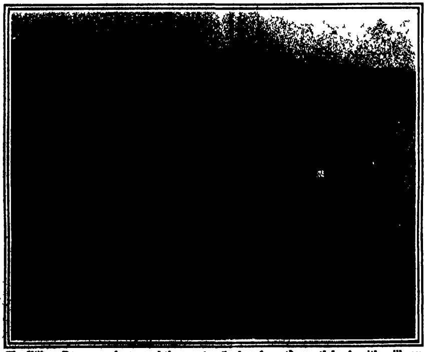
What remains to be done is not so much to convince the average man of its desirability on theoretical grounds, but that he should contribute his share to making the change. This the book attempts to do, and seems to accomplish with conviction. It points out what seems quite possible, namely, that after two or three weeks of attention to the metric system as it would touch us in our daily lives, we should have a good command of it and its arbitrary values. However, the greatest obstacle to overcome is not mental or temperamental, but is inherent in inanimate and tangible things—the things that go to make up our ordered and mechanically dominated lives today such as parts of motor cars and the uniform length of a roll of butter We live in a mechanical age when everything about us is standardized on a basis, chiefly the duodecimal, that sets the size, weight and volume of things that we use far more often than we realize. It is the transition from the system of machine tools which are set to produce these things, many of which cannot be set otherwise without rebuilding that bulks large in the mind of the engineering world But these arguments the book under discussion claims to have refuted It states that many American manufacturers are using the metric system of measurements today for the production of export articles They have stated in some cases that the necessary change in standards was effected without annoyance and that the use of the metric system has so greatly reduced certain costs as to more than pay for itself But in the last analysis the decision of whether the system should be used will depend on the feelings of the individual, and these have not yet been worked around to the point where the average American or Englishman is willing to make the break.

Ro

RO is a language, but there is no Land of Ro It is used all over the world, yet the world does not use it It is a tongue made up out of whole cloth, on a basis of usability With a knowledge of it the world would become one nation, for language is a barrier that begets many misunderstandings between peoples who have no way to communicate their ideas in a clear manner, fully and completely If Ro, or any other of the several machine-made tongues, could be "put over" in a day, if we could all go to bed saying "Good Night," or "Bon Soir," or whatever good night is in Swahili, and wake up saying "Good Morning" in Ro—and go on talking it the rest of our lives just as we formerly spoke our own tongue, this would soon be a better world to live in Or if we could all by some magic be made to talk something like this—"El ye ni elkno uq zad fas ov riceler al kiwap ov temeler ap asod ro", or if when we miss our train we could make sounds like this, "Uf abs hogem ut muyab el kibeger odj at tecor fas ov ade ragapars in at boba ov kecab, amit awik ni hab ad kibeg udae in boba ov ro"—if we could utter these noble accents, how much sweeter life would be!

But folks won't. They, including ourselves, prefer to "walk in the ancient ways," as per Confucius.

The fact is, another "Ro" is being built now We speak it The world is turning more and more to it as a language of business and commerce· English



The Wilson Dam powerhouse and the great cofferdam from the south bank, with spillway section in the distance

Man has been developing a few hundreds of different tongues since a few hundred thousands of years. It has always been a diverging movement, the tongues have always differentiated. But the age of machinery with rapid, easy travel, has mixed the world's people The age of printing and electricity has already mixed our languages. In a real sense this process has been going on but a century, yet already there is a strong converging force in the world's speech. It is coming down before long, comparatively speaking, to one tongue That tongue will hardly be exactly English, or French—or any other Rather will it be a mixture Already there is a vast infiltration of words between the leading European languages, and this process is bound to occur even more extensively in the future A "struggle for existence" is going on between words, and the "fittest will survive" Nobody will have expended any conscious gray matter over it or if they do it will have been as vain a thing as the efforts of certain people to guide the course of styles in feminine wear along a rational, predetermined course There will be a "universal language," not so perfect, not so mathematically constructed as Ro. But it will not be Ro

Uncle Sam's Agricultural Proving Grounds

The Federal Farms Where Problems of Vital Import to American Agriculture Are Investigated

By Ralph Howard

PROBABLY the most of us who are not intimately familiar with the minute ramifications of the national Department of Agriculture visualize this branch of the Government merely as a group of beautiful and ornamental buildings inhabited by expert scientists who are familiar with all the complexities of crop production and animal industry. Such a supposition is all right as far as it goes. But Uncle Sam as a farmer is not content to assimilate all his lore from ponderous tomes and voluminous treatises. He is an active, regular "dirt" farmer who likes to mix things up with the mellow earth and who prefers to learn at firsthand about the idiosyncrasies and peculiarities of his live stock. That is why he maintains the greatest agricultural proving grounds in the whole world—annually productive of facts and figures of immeasurable value to the soil-tilling universe, in general, and to the American farmer and his folks, in particular. This is the story that Mr Howard tells us here.—THE EDITOR

BELTSVILLE Md 14 miles northeast of Washington is the site of the 475-acre animal husbandry and dairy farm of the Federal Government It is close enough to the scientific laboratories and offices of the scientists to be readily accessible while far enough out in the country to be a regular dirt farmer's farm managed and operated along practical lines With its complete equipment and extensive quotas of live stock of the leading breeds and classes it can undertake investigations which are beyond the compass of the average state agricultural college and experiment station while still cooperating with the 48 experiment stations so that its findings may be verified in other sections of the country

The Beltsville Experimental Farm was purchased and established ten years ago when the need for agricultural proving grounds along animal husbandry and dairying lines was keenly evident The dairy farm of 187 acres has a live stock population of 150 animals of the Holstein Jersey and Guernsey breeds and is fully equipped and developed as a modern and progressive milk farm The animal husbandry farm aggregates 288 acres and boasts substantial and serviceable buildings and improvements

A visit to Beltsville Experimental Farm is as interesting and instructive as attendance at the bonanza state fairs and live stock expositions. Practical investigations of vast economic importance to live stock farmers are constantly in progress at the government farm and usually so much is going on there that a visitor feels as though he had attended the biggest six ring circus under the sun Sheep hogs cattle milch goats horses and poultry are being raised fed and studied in large number The milch goats of the leading breeds are centralized in a milking herd which is maintained under such sanitary and practical conditions in a special stable that milk free of all odor and taint and more palatable and thirst appeasing even than cow's milk is produced

The goats are economical producers of milk which is especially well adapted for the feeding of puny infants and invalids Two milking does can be fed and maintained at less cost than the average family cow and they will produce as much or more milk In the neighborhood of large cities there always is opportunity for the establishment of a practical and profitable goat dairy

Beltsville Farm really is a huge laboratory for the study of the principles and practices of animal breeding The farm has enough pure-bred Berkshire Poland China Duroc Jersey Chester White and Tamworth sows so that the spring pig crop usually runs well over 200 head Enough foundation poultry of the leading breeds is maintained so that the annual crop of chickens is around 5000 The flock of Southdown sheep which is handled strictly on a farm basis is without equal in the United States

The problem of the eastern and southern farmer often is that of keeping his flock of sheep on a limited area The government specialists have accomplished some extremely mentionworthy results on one 33 acre field at Beltsville Four years ago the stock-carrying capacity of this field was limited to 44 ewes and 33 lambs At present it supports in contentment and plenty more than 100 ewes and their progeny Other practical problems of breeding feeding and sensible management of the flock are constantly under scrutiny and consideration and its activities have been of pronounced profit to sheep raisers the country over

The poultry investigations have demonstrated that the utility production of poultry can be combined with standard breeding All the hens and roosters have been standard bred since the inception of the flock and no birds are retained for breeding operations which will not qualify under the American standard of perfection Uncle Sam has established a strain of White Leghorns, the majority of the females of which are producing 200 eggs or better during their pullet year A majority of the individual males and females in the flock are good enough in form feather and fitness to win in any show which is held in the United States. Most of the work has been done with White Leghorns and Rhode Island Reds although many specimens of the other leading breeds and classes are also maintained. These birds have been trapnested and therefore pedigreed for four full generations The Federal poultry experts have also developed a new breed of poultry which is more robust, larger and healthier and which produces as well as the Leghorns—or better These fowl have been obtained from judicious crossing of the English Dorking, White Leghorn and White Plymouth Rock breeds

One of the outstanding achievements which has resulted from the swine breeding and feeding investigations at Beltsville has been the practical demonstration of the adaptability and value of fish meal as a protein-rich nutrient for use as a substitute for tankage and blood meal in the porker rations Government tests at Beltsville showed that there was practically no difference in the feeding value of fish meal and tankage and that the use of the former material in no respect tainted nor flavored the pork This frees the hog industry from the limitations imposed by the insufficient supply of packing plant tankage, and is therefore of basic importance to the swine-growing industry Furthermore it leads to the efficient utilization of millions of tons of low grade and by product fish available along the Atlantic and Pacific coasts which heretofore have gone to waste

The animal husbandry experts ascertained that it cost between one and one-half and five cents more per pound to grow and fatten lousy hogs than it did to develop porkers which were free from such parasites. It is such a simple matter to keep porkers free of blood sucking pests of this description that the results of this experiment have exerted a beneficial influence on hog management principles from coast to coast.

At this writing the animal husbandry department is beginning investigations of the causes of soft pork Throughout the southern states hogs are fattened largely on peanuts. However the exclusive feeding of peanuts results in the manufacture of soft, oily and greasy pork which does not keep well and which is discriminated against in the market The solution of this problem will be of vital value to the hog growers who live south of the Mason and Dixon line.

Little is done at Beltsville in studying horse and cattle feeding and breeding Four state cattle stations at Lewisburg, W Va Manhattan, Kan, McNeill, Miss, and Jonesboro, Ark., are used as government grounds in their various localities. The work at Manhattan in cooperation with the state experiment station is exceptionally interesting. A herd of Shorthorn cattle has been under observation for five years and it is anticipated that it will take about 15 years more of study before the experiments are brought to a definite conclusion. The purpose of the tests is to determine the correlation between the milking function and the production of high quality beef, the effect which the milking tendency of the dam exerts on the male and female progeny and whether it is possible to develop and intensify the milking characters and still maintain in perfection the beef giving properties.

Along about 1907 when the extinction of the Morgan horse was threatened, the Morgan Horse Farm of Uncle Sam was established at Middlebury, Vt., for the rehabilitation and development of this splendid breed. At this writing, the farm covers 960 acres and has a horse population of 75 excellent animals. This farm has resulted in a new lease of life for the Morgan horse.

At Buffalo, Wyo., is another of Uncle Sam's horse farms where is well under way the breeding of American utility horses—a native breed which the Department of Agriculture is trying to develop in cooperation with the Wyoming Experiment Station. For the most part, standard-bred mares are being used as foundation stock although some saddle, Morgan and thoroughbred blood is also in evidence. The results of these breeding operations indicate that, ultimately the new and native breed will be permanently fixed in type

The government sheep farm at DuBois, Idaho covers 28,000 acres and now numbers over 2000 Rambouillet, Corriedale and Columbia sheep—the latter a new breed created and developed by the Department of Agriculture. By mating the ewes of one generation with rams of the previous generation, without ever reverting to the use of the early foundation blood, the new breed has been permanently established in five years and is the first example of its kind which has been perfected in such a brief period Also, at the DuBois farm it has been ascertained that under range conditions as much wool is obtained from the breeds of sheep with bare faces as from those bearing wool from their noses to their toes. The sheep with wool on their faces have always been pronounced subject to snow blindness because the snow and moisture would clog and freeze on their woolly faces.

Extremely valuable work is also being done at Beltsville Farm along the line of animal genetics. At the present time, the investigations have covered 21 generations of guinea pigs with the result that data of immeasurable importance have resulted. It is proposed to continue these experiments, using larger animals more closely related to man and his mates than are the guinea pigs and in this way to check the initial findings.

The Beltsville Dairy Farm is now engaged in one of the most important breeding experiments ever attempted The purpose is to ascertain how best to develop a strain of cattle which will be uniformly high producers—whether by line breeding or by outcrossing It is anticipated that it will take from 20 to 25 years to bring this investigation to a conclusion. All the heifers which result from these matings are being kept in the Beltsville herd while some of the male progeny are being loaned to a few of the southern agricultural colleges which are cooperating in the work which already has run for four years

Another investigation which promises more efficient feeding methods involves the testing out of various protein feeds to determine which are the most productive of maximum milk flow Some proteins are more productive of amino-acids than others, with the result that they engender heavier milk yield. The testing of the protein feeds to find out which are the heaviest carriers of amino-acids is bringing to light the materials which are best adapted for use in the cow's daily dietary

Other tests are being conducted to decide whether it is preferable to milk two or three times daily whether it pays to water the cows two or three times a day where the animals are stabled whether the box stall or stanchion system of stabling is most desirable for the valuable pure bred individual, and what mixtures make the best substitute combination to use instead of whole milk in calf-feeding. Valuable results have obtained from the Federal findings that cows must be supplied with mineral salts rich in calcium and phosphorus if they are to maintain their heavy yields of milk.

Recently the cottonseed-oil industry has perfected a new method of extracting oil from cotton seed. The by-product is different from cottonseed meal and cake. The cottonseed crushers have requested the Department of Agriculture to find out its feeding value, and this is being done at Beltsville Farm. Studies also have been made of the feeding value of different kinds of silage.

In order that the dairy experts may be in intimate touch with commercial dairy projects, Uncle Sam acts as supervising expert for the Grove City, Pa., creamery, which makes all its products and operates its factory according to methods recommended by the government. This permits of trying out under commercial conditions, the methods devised in the laboratory.

In addition to the Beltsville Dairy Farm, the Federal Dairy Division also operates 12 other cooperative dairy farms which range from 200 to 1000 acres in size and which are located all over the dairying country. Arlington Farm—the 400-acre crop and fruit proving grounds of the national government—abuts the Potomac River and at one time was a part of the Park Custis Estate owned by George Washington. Just as Beltsville is

returns which the sweet potato and trucking industries alone have realized from the Arlington Farm experiments has more than repaid the Government for its establishment and maintenance.

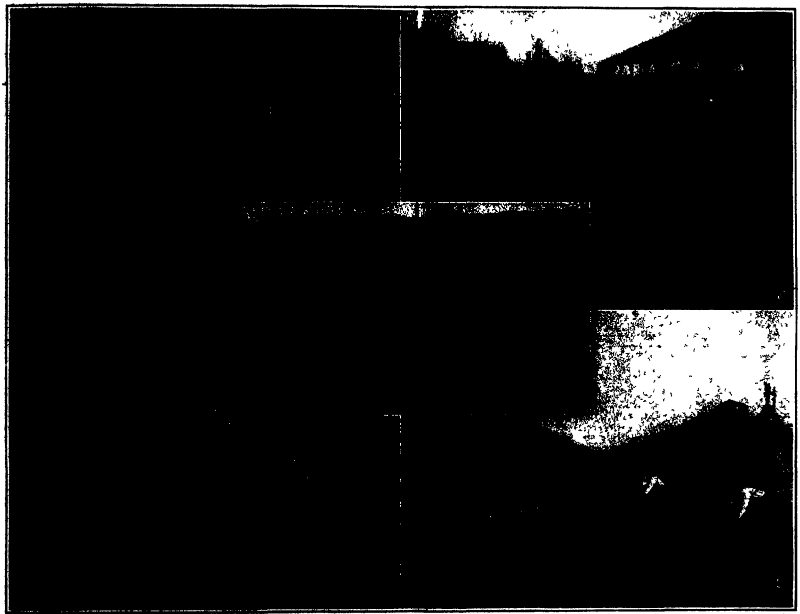
From 600 to 700 varieties of apple trees, 300 varieties of grapes and 400 varieties of peaches are now being tested out. The vegetable trial grounds frequently contain as many as 1200 different varieties while the sweet potato plots not uncommonly are planted to 100 different kinds of yams. The place is so laid out that all the buildings are heated from a central plant while a huge water supply is piped to all parts of the grounds.

Just to illustrate how important it is that the truck farmer use only specially selected seed of the best varieties, the experiences of a Maryland trucking region

phorus-depleted soils. This is one of the greatest fertilizer discoveries of the modern era as it eliminates the previous transportation problems which were associated with the shipment of phosphorus in the ground rock form long distances from the mines to the fields.

The investigations of the Bureau of Plant Industry which led to the definite conclusions that plant growth is dependent almost exclusively on the length of daylight to which it is exposed were also performed at Arlington Farm. These investigations have been proclaimed by plant pathologists to be the most important discoveries ever made by the Department of Agriculture.

Uncle Sam's farming scientists are constantly on the hunt for new cereals, forages and grasses adapted to the soils and climatic conditions in this country. As



1. All the goat's milk produced at Beltsville is used in the laboratory production and testing of "foreign" cheeses. 2. Antemortem examination of experimental hogs at the Beltsville farm. 3. The Federal farm at Arlington is the largest of the sort in the world. 4. The Oils and Fats Laboratory of the Department of Agriculture which at present is making a special investigation of cottonseed oil. 5. Dark-house laboratory at Arlington, where is studied the effect of light and dark on plant growth

Glimpses from the United States Government's Experimental Farms in Virginia

without equal throughout the entire world as an animal farm devoted to scientific investigations, so Arlington is without peer as a testing ground for crops, fruits, fertilizers and practically all kinds of plants known to farming science, both in this country and abroad.

The farm consists of two types of soil—a heavy clay which is typical of the Coastal Plains region from Washington to Georgia and an alluvial soil typical of all the leading trucking areas from Long Island to Florida. This means that every crop which can be produced successfully at Arlington Farm can also be grown over the belt under discussion, other conditions being equal. All the foreign forage and cereals as well as [illegible] which have been acclimated to American conditions have been tested out at one time or another at Arlington Farm. The Farm is replete in storage and [illegible] laboratories where conditions in cold storage or [illegible] can be duplicated. In fact, the financial

are illuminative. A storekeeper in this area sold large amounts of tomato seed to the neighboring farmers, accepting the word of the wholesaler from whom he purchased the seed that it was of good quality and adapted to use in the locality. The tomatoes were destined for use in the local cannery. When the plants began to ripen it was evident that all the tomatoes were yellow instead of red and practically valueless so far as canning operations were concerned. Hence due to the unreliable seed supply the chief cash crop of the entire locality was ruined at a time when red tomatoes of similar size and excellence were selling for $50 a ton. Federal control prevents such catastrophes.

The Bureau of Soils as a result of its experiments at Arlington Farm has recently devised a blast-furnace method of extracting phosphoric acid from phosphate rock so that the product can be bottled and sold commercially to farmers for the replenishing of their phos-

a result they are running trials every growing season of hundreds of crops of overseas origin. Through tests of this description napier grass, sudan grass, carib grass, Rhodes grass, velvet beans, feterita, hegari, cowpeas and over 1000 different varieties of soy beans have been introduced. In addition, experimental work is perpetually in progress in improving the types of the crops now in general use. The Government experts are always busy with the colossal task of finding new crops which are better adapted than those already in use for culture in certain sections of the country. In this way they introduced alfalfa to the western states, sorghums to the Southwest and the velvet bean to the Gulf Coast states. Despite that the general opinion among laymen is to the effect that all the valuable farm crops worth working with have already been discovered, there are thousands of plants of possible utility as producers of forage which as yet have never been studied.

Our Point of View

An Editorial Grievance

PSYCHIC research involves two major questions. The first is: do the phenomena of mediumship occur in good faith, without fraud or trickery on the part of the medium? The second arises only after an affirmative answer is given to the first, granted that they do so occur, what is their cause and *modus operandi?*

There is no ground for predicting, *a priori*, that the average mortal would confuse these questions, and be unable to discuss the one without dragging in the other. *There is no ground for predicting that, of the numerous answers which might be suggested to the second question, any particular one would occupy such a large place in the public mind as to stand for the whole subject matter of psychic research.* Yet both these things have happened, and herein is our grievance alluded to above. With both the written and the spoken word, we have, after persistent effort, signally failed to impress upon our audience.

First, that one can deal with the occurrence of psychic phenomena without at all attacking their cause.

Second, that one can deal with their occurrence, and even come to a conclusion that they do occur, without giving any consideration to the question of individual survival of death, and without saying anything that in the least degree involves this question.

Third, and more specifically, that our own psychic investigation has not so far had anything to do with spirits, spooks, ghosts, or whatever you wish to call them, and that it is entirely possible for us to push it to conclusion without its ever coming to have anything to do with spirits, with spiritism, or with the hypothesis of spirit survival and communication.

As an alternative to the belief that the world is in an incredibly illogical mood, we have examined our own utterances on these points. They seem quite unambiguous—clear enough, beyond all doubt, to dispose of the thought that the rest of the world is sane, while we are unable to put a simple thought in intelligible words. Yet with negligible exceptions, the world goes right on linking us with the spirits, assuming merrily and whole-heartedly that our finding will necessarily be an endorsement or a repudiation of the spirits, that it is the spirits and nothing else that we are investigating.

Nor is this all. We believe we have made it sufficiently clear that the invasion of European psychic centers by one of our staff has no direct connection with our formal investigation here. This member of our staff has, we believe, made it singularly clear that, while it is quite impossible for him to attend seances of such varied character and so rich in incident without bringing away some very definite impressions as to the probabilities of the fraudulent production of what he has seen, these remain impressions of the probabilities and nothing more. Yet he has been widely misrepresented as one who has stolen his Committee's functions, who has demonstrated himself to be a credulous simpleton, and who has stated that what he saw convinced him of the reality of the phenomena.

Again, we have repeatedly pointed out that a fair-minded investigator may form no prejudgment, and have repeatedly set down the necessity for not leaning toward or against the phenomena. And the world goes right on honoring the one-half of this warning in the observance and the other half in the breach—insisting that the investigator must not admit in advance that maybe the phenomena occur, but granting him the privilege of insisting as vehemently as he pleases that they cannot and do not occur. Worse, it goes right on assuming that this is what we mean, and castigating us when we depart from this standard.

Of course the reason for all this is that in the psychic field as in no other, most of us have our own violent preconceived opinions. Any statement read or heard offers two alternatives—to twist it into agreement with these opinions, or to twist it into disagreement and reject it. We should be vastly pleased if the world would overcome its tendency to prejudge this subject. Failing this, we should be almost as well pleased if everybody would believe that, on this subject as on others, we speak after due thought for the form of our utterance, and mean exactly what we say. Much misunderstanding would be avoided if this could be done, for we cannot possibly correct every published misstatement of our attitude, even if we could be sure that all such come to our attention.

Making Airplane Travel Safe

THE DISASTER on the Paris-London Airplane Service, when a machine burst into flames and fell, carrying six people to their death at Monsures, France, was a tragedy which is certain to emphasize in the minds of the public the danger of airplane travel. Nevertheless, we should guard against giving an exaggerated importance to this event by bearing in mind the many millions of miles that have been flown without any fatalities. We must keep our sense of proportion and consider the wonderful record of our aerial postal service and the fact that commercial service has to its credit the fact that one American company in 1922 made over 2000 flights and carried over 9000 passengers without an accident, and that the British service had a record for the same year of 930,000 miles flown without a fatal accident. Also, it will help us to a true judgment of the safety of airplane travel, if we bear in mind that, even today, it is a comparatively new art and that some of its major problems have yet to be solved. They will be solved and travel by air will become as safe as travel by train or ship. Statistics of travel show that the railroad train is so secure that a passenger runs less risk of accident than he does on the streets of any great city. Yet, we must not forget that the toll of injury and death in the days of early railroad development was both large and continuous. Rails would break, the track would spread, broken wheels and broken axles were common, bridges collapsed, and the frequent collisions took a frightful toll of human life.

Again, just at the time when the steamship companies were publishing perfectly correct statistics to show that the risk of travel by sea to the individual passenger had been reduced almost to zero, there came, like a bolt out of the blue, news of the sinking of the world's latest and largest steamship with the loss of some 1500 lives. Yet, large as was the death toll, when it came to be applied to the general average, the risk to the individual was raised but very slightly.

But after all is said and done, it cannot be denied that the problem before the builder is to make the airplane so safe that the passenger will take his seat in a commercial machine with something of that same confidence with which he starts upon a trip by rail or steamship. The growing tendency to use all metal construction augurs well for safe travel in the future. Fire communicating from the engine to the gasoline tank is a terrible danger, but it becomes greatly intensified if the fire takes hold of the combustible material of a wood and fabric machine. Hence we look for all-metal to be recognized as the *sine qua non* of commercial airship construction. The possibility of a back-fire from the engine will always be present with the current type of engine; but something surely can be done to prevent the flame from communicating with the gas tank; and it should be possible to mount the gas tank, so that by the pull of a lever it could be dropped clear of the machine as freely as an airman drops a bomb.

The Flurry Over Naval Gun Elevation

THOSE who read the article by our naval correspondent in London, giving the facts as to the elevation of British guns, will realize how purely artificial and thoroughly misleading was the recent excitement on this subject in our daily press. It was indeed a veritable "tempest in a teapot." Mr. Bywater traces the development of the mounting of naval guns from the days of Nelson to those of the great war, and we learn that, with the exception of the "Hood," the maximum elevation of the guns on the existing battleships was determined before 1914, and that on not a single ship has it been changed since then.

The interest in the subject of extreme range is due to the introduction of airplane spotting. Before 1914, ten to twelve thousand yards was considered to be the extreme range at which engagements would take place. Spotting, or observing the fall of the shots, was done from the fire-control platform at the top of the mast, and beyond those ranges it became increasingly difficult to spot with serviceable accuracy. Hence the use of the airplane, which enables the spotter, looking down from his lofty elevation, to note the fall of the shots and estimate, with accuracy, how far they are over or short of the target, even when the target is hull down and invisible from the firing ship.

Personally we do not believe that in actual battle a judicious Admiral will wish to fire away much of his limited amount of ammunition at ranges, where, even with the assistance of airplane spotting, the chance of landing on the enemy will be small, and surely out of proportion to the amount of ammunition expended.

Let us consider the routine of airplane spotting, say at a range of 30,000 yards, and see what interval of time there is between the fall of one salvo and that of the next, as corrected by the spotter. After seeing the splash, a second or two is consumed by the aviator in determining its position in reference to the target; it takes additional seconds to wireless this "spot" to the ship; a few more seconds to receive the message. Then, in the central station, the corrections must be applied, the change in elevation in guns determined, and this change applied to the sights, before another salvo is let go. Let us suppose that sixty seconds are consumed in all these operations. A salvo at 30,000 yards range will take about sixty two seconds to reach the target, so that between the time when the enemy ship perceives the fall of one salvo and notes the arrival of the next and corrected salvo, there will be an interval of two minutes and possibly more. If he changes his course as much as four points, or 45 degrees, as the German battleships did frequently in the battle of Jutland, and if his speed is 20 knots, he will have moved his ships some 2800 feet to the right or left of his course before the arrival of the corrected salvo, calculated upon the assumption that he will maintain his original course.

Upon these considerations we base our belief that the distance at which actions can be fought will be determined by the speed of the slowest ship and the range of the lightest guns, and not by the maximum range of individual ships. Beatty had a maximum range, as shown by our table, of nearly 24,000 yards, and, although he had the speed-gage of the enemy, he preferred to open the fight at 16,000 to 18,000 yards.

A Notable Venture in Education

WIDESPREAD attention is being drawn to a system of education, which has been launched by Mr. Arthur E. Morgan, President of Antioch College, whom the readers of the SCIENTIFIC AMERICAN will recognize as the author of the successful flood-control scheme, known as the Miami Conservancy Project in Ohio. In the course of his twenty years' experience as a hydraulic engineer, Mr. Morgan has had in his employ some 2000 graduates of liberal colleges and technical schools, and a close analysis of the failure of many of these young men to make good to the extent to which their education and natural capabilities gave promise, led him to make a broad study of the educational problem. This resulted in what has come to be known as the Antioch Plan, which Dr. Charles W. Eliot has called "the most interesting enterprise in education now going on in our country."

Fundamentally, the experiment that has been carried on at Antioch College for the past two years is the

Our Point of View

atest and most ambitious of those schemes of education which combine with the college course a certain amount of practical outside work in the field, the factory, or the office. But it differs from all its predecessors in the fact that whereas, hitherto, the outside work has been regarded as accessory or supplemental to the class-room, in the Antioch system it is given a position of equal importance, and the time of the student is divided equally between the two. Thus, study at the college and work in factory or office take place in five-week periods; each job being held by a pair of students, who alternate between the study and the shop in five-week shifts.

The fundamental aim is to secure a well-proportioned training, which shall include the development of all the qualities which make for a well-rounded personality, a liberal culture, and a useful knowledge of the conditions in industrial, commercial, or professional work a-day life. With such an equipment, the Antioch student should fall more quickly into his stride than the young man who on leaving college must adjust himself as best he may, to the untried ways of life in the outside world.

We are all familiar with the age-long controversy as to the respective values—the values expressed in efficiency—of the "college-bred" and the "self-made" man Antioch aims to send its graduates out into the world, equipped with the culture and mental training of the one and the practical knowledge of men and methods of the other Obviously, to secure this dual training requires a longer college course than the usual four years, and the course at Antioch calls for forty five weeks of study and work during each of six successive years.

An incidental but important advantage is the fact that the students become practically self-supporting, the usually haphazard process of "working one's way through college" being changed into a systematic part of education. The more important object, however, is the development, through self-imposed discipline, in real situations, of those qualities which are conspicuous in the "self-made man, qualities such as courage, initiative, the sense of responsibility, and the ability to measure one's powers.

And so it comes that the student has six yearly opportunities to determine, by actual experience, the calling for which he is best fitted

It is scarcely possible to overstress the importance of that hour when a young college graduate, standing on the threshold of life, has to choose a career To him the field is all untried, and, except in the case of specialized schools and colleges, or of those who take special courses, the choice is made on no more rational ground than that of the child's "I want to be" an engineer, lawyer or merchant. If the choice should happen to be suitable to his character and capabilities well and good. But if not, one of two things will happen the young man of courage and resourcefulness will "circulate around" until he finds the work that falls in with his training and capacities, or if, because of an inherent timidity, he is lacking in initiative, he will go to swell that great army of employes in whom a distaste for their work has stifled all active ambition.

The Antioch scheme aims to prevent the occurrence of such tragic failures by launching the graduate upon a carefully-chosen career, enriched with a liberal education, and equipped with several years of practical experience.

Progress in Railroad Electrification

THE APPLICATION of electric traction to the railroads of the United States is proceeding quite closely along the lines which were predicted fifteen or twenty years ago At that time two ambitious schemes of railroad electrification has been decided upon after thorough investigation of the problem by expert committees, namely, the complete electric operation of the new Grand Central Station, New York, and of a zone of thirty miles of the New York Central's line between New York and Croton on the Hudson The other project was the electrification of the New Haven line four track line between New York and New Haven

The public was quick to realize the grand scale upon which this electrification of the steam railroads of the country was being commenced, and predictions were freely made that, within a decade or so, steam would give way entirely to electricity and the steam locomotive would take its place in historical museums As usual, the imagination of the public ran far ahead of the facts, and the electrical engineers of the day made haste to explain that, for many years to come, the electrification of the railroad system of the country would be confined to city terminals, to heavy suburban passenger traffic, and to the mountain divisions of the railroads where the grades were heavy and where water power was available

The history for the past fifteen years has proved the truth of these predictions for electrification has been applied on a large scale only to city terminals and suburban service and to the heavy grades of mountain divisions. The latest development of this kind is the decision of the Virginia Railroad to electrify 134 miles of their system lying between Roanoke, Va, and Mullens, W Va This stretch includes the mountain division where the line crosses the Allegheny Mountains, and it includes a heavy grade of about 2 per cent over which the coal must be hauled on its way east to tidewater The Westinghouse Company states that this is the largest single railroad electrification contract which has ever been placed The great advantage of electric over steam operation on such a stretch of line is shown by the fact that, under existing conditions, three Mallett locomotives are required to haul 5500-ton trains to the eastward, up the 2 per cent grade above mentioned, at a speed of seven miles per hour The electric locomotives will be able to haul trains of six thousand tons at fourteen miles per hour up the same grade

Strength of Metals Under High Temperature

THE GREAT advance which has taken place in working steam pressures with its consequent rise of temperature renders the question of the strength of metals under high temperature of increasing importance Furthermore the gas turbine is now seeking admission into the field of rotary prime movers, and the necessarily high working temperatures of the gas will render still more urgent the problem of providing metals which can be subjected to high temperature without a prohibitive loss of strength

We have before us a diagram showing the temperature effect on the tensile strength of certain metals, published in the April issue of the *Marine Engineer and Naval Architect*, and compiled from data published by the Directorate of Research of the Air Ministry, which throws valuable light upon this subject Thus we learn that there is generally a rapid fall in strength with rise of temperature, which is so rapid in bronzes and muntz metals, that the manganese bronze specimen, which had a tensile strength of 41 tons at 100 degrees, fell to 21 tons at 460 degrees and 6½ tons at 750 degrees, while the electro steel test piece fell from 28 tons at 50 degrees to 16¼ tons at 850 degrees.

The best results were obtained with a five-per-cent nickel steel, containing 0.005 per cent of carbon which dropped from a tensile strength of 40 tons at 50 degrees to 39.2 tons at 210 degrees to 35.2 at 380 degrees, and then rose to 30 tons at 570 degrees. Naturally the behavior of this alloy is variable according to the percentage of nickel employed. Above five per cent the efficiency at first deteriorates, but with as high as 35 per cent nickel a tensile strength of 22 tons per square inch was obtained at a temperature between 900 and 1000 degrees Fahrenheit The highest strength at the highest temperature was 28 tons at 1300 degrees Fahrenheit this with a nickel chromium steel

Excellent results were obtained in the Royal Air Force with the exhaust-gas turbine super-charger for supplying air under pressure to carburetors at high altitudes. Although the Tungsten steel rotors were only a few inches in diameter, they ran with a blade speed of over 800 feet per second in a temperature of about 1200 degrees Fahrenheit Coming now to the gas turbine, Holzwarth, in describing his gas turbine tests, stated that he used electro steel with a yield point of 13 tons, and a breaking strain of 17 tons, at a temperature of between 800 and 900 degrees Fahrenheit, the strength of his material at 60 degrees Fahrenheit being respectively 23 and 28 tons per square inch

We must beware of drawing hasty conclusions from the above results. Before they can be considered reliable, the time element must enter into the tests, for we are told that in the case of alloys there has been noted a tendency for the constituent elements to separate out under high temperature of continuous duration.

Seventy five Years Ago

THE SCIENTIFIC AMERICAN seems to have given as much attention to the sea and ships seventy five years ago as it does today, but how does this strike you for a prediction. "Perhaps it would not be too much to predict that in fifty years more sailing vessels will scarcely be known on the Atlantic, and for $50 any citizen will be able to go and visit London and return to New York" A safe prophesy except as to the price

Another reference which will interest every navigator is the following "Lieutenant Maury has published some charts of 'Winds & Currents' He has discovered a region of better winds along the great circle to South America, whereby the passage to Rio, China and all places south of the equator is shortened some ten to fifteen days" Any navigator who sent the track of his vessel with a record of his winds and currents to Washington was supplied with a set of these invaluable charts.

The Coast Survey was doing good work seventy five years ago in the collection of specimens from soundings. Mention is made of the fact that Professor Agassiz accompanied Captain Davis on his hydrographical work for the Coast Survey, and that he had reaped a rich harvest of discovery, relative to the animals which inhabit different depths of the water

The Editor grows enthusiastic over the new "Croton Bridge," now known as the "High Bridge," and asks. "What bridge of old can compare with the great Croton Aqueduct Bridge now in the course of erection over the Harlem River in this city? This great work is the more astonishing when we take into consideration that it is a conduit for water brought for a distance of forty miles to supply a city teeming with 400,000 inhabitants' The city government of today understands better the value of art and history and sentiment for it contemplates throwing this noble bridge into the discard

Some statistics regarding the English railroads are given from which we learn that the total length of all roads was 3053 miles. There was an act of Parliament requiring that cheap trains be run to the extent of one daily, carrying passengers at not over a penny a mile at a speed of not less than twelve miles. It was further required 'that carriages be provided with seats and protected from the weather"

A letter from R. V De Witt in our issue of June 17, 1848, refers to a copy of Ramelli's early work on mechanics, etc., which he sold to the Patent Office, with the result that "a number of applications ready for the seal, were rejected by reason of their exhibition in its pages.' Commenting on this letter the editor writes "This is another nail to the argument for the Smithson fund to publish a work on the progress of inventions. No one would believe, unless he had really experience of the fact the great amount of time and money expended every year in inventing something old."

Our First Test Seances

The Report of the Sub-Committee and Some Details of the Sittings

By J. Malcolm Bird, Secretary of the Committee of Judges

WHEN I was in Berlin in March, I went through the Grunewald psychic laboratory which was described in our issue of July 1922 Herr Grunewald has the finest array of scientific apparatus for testing mediumship to be found anywhere in the world But after you have seen it all he sighs gently and expresses a quaint regret that all this equipment has been two years idle Other investigators have mediums and no laboratory he complains he has his laboratory and no medium

For four months the SCIENTIFIC AMERICAN has been in the same boat Our psychic investigation has been theoretically under way all this time but no mediums had come forward to be investigated The period of watchful waiting was finally broken with seances by a medium whom we shall designate as Mr X on May 21, 22 and 24 We have held this issue from the press in order to include in it an account of what happened

The seances were held in our library The table and desk were put out of the way in the corners leaving ample space in the center of the room By blanketing the door and the two windows with black muslin we were able to exclude all light and get the same brand of total darkness that has already had my testimonial in connection with informal seances Unbroken rows of shelves line the two long sides of the room The medium agreed that these were not likely to interfere with the psychic forces

Sittings were held during the evening hours when downtown New York is inhabited by the cleaning women Our black hangings and our mysterious noises emanating from a sealed room struck panic into the souls of those stationed on our floor they were with the utmost difficulty prevented from fleeing the place The least they looked for apparently was a first-class murder with a mangled and bloody corpse

Permanent sitters were Mr Walker and Mr Lescarboura of our staff with myself Mr Owen of the *Times* Mr Granville Lehmann of the American Telephone and Telegraph Company and a friend of the medium from back home whom we may call Mr Smith Drs Carrington and Prince of the Committee of Judges sat on Monday Dr Prince and Houdini on Thursday on Tuesday the Committee was represented by Mr Frederick Keating a local conjurer Other sitters were visitors

This medium does not go into trance he occupies a chair in the center of the circle and comports himself quite like the other members of the group The seance is opened with the Lord's Prayer after which hymns and familiar songs are sung and conversation carried on quite as in the usual seance Mr Smith leads the prayer chooses the songs and the moment for singing them and leads the attack upon them The medium has an admirable voice and joins freely in the singing and the talking

This medium has a wealth of spirit controls—nine we were told We heard from Dr Barnett a physician and chemist who speaks in a deep trumpet voice Bert an Englishman with a shrill falsetto Kokum Hawk Chief Oseola and a fourth Indian, all rather deep-voiced but quite distinguishable from one another Mr Smith's baby boy who whispers to his daddy and Christo di Angelo a singing Italian The phenomena include these trumpet and independent voices movements of and tappings upon the trumpet touching of the sitters with the trumpets and with materialised hands psychic lights and psychic movement of and playing on a guitar

To get the medium accustomed to the sitters and vice versa, Monday's session was held without test conditions, being quite a duplication of the informal sittings I have held with numerous mediums. The trumpet was supplied by the medium, and left with us until the sittings were over It carried a luminous band at its larger end but on Tuesday the medium without previous warning brought in a second unmarked trumpet. This too, was left with us until after Thursday's sitting Both trumpets were quite harmless.

At Monday's sitting the phenomena were very disjointed. We sat for half an hour before I was touched on the chest apparently by a hand. An interval of ten minutes then ensued before Dr Barnett announced his presence through the trumpet. Throughout the evening a wait of some minutes thus came between phenomena and the manifestations themselves were extremely brief All that occurred came with a suddenness well calculated to startle the sitters into momentary inability to observe closely and was gone before that ability was regained.

The voices were fairly high in the room save for Bobby's Touches came usually on knees or thighs less often on hands chest or top of head Mr Lescarboura after the touching began slipped his chair back out of the circle as far as it would go—about four feet he thought He was the last to be touched but ultimately the toucher found him When one of the sitters made the observation that all had confessed to a touch save Dr Prince Bert's voice piped up 'Dr Prince has been touched but hasn't admitted it The Doctor verified this explaining that he hadn't attached any importance to the touch any of his neighbors might as well as not have done it This was the longest speech by any of the voices until the very end when we were dismissed by Dr Barnett with a promise of more generous results for the next night

The Deadly Parallel

THE MEDIUM	THE PHENOMENA
9 36—Out of chair 15 seconds.	Trumpet voice, Houdini touched
9 37—Out of chair 3 seconds.	Tapping on surface of trumpet.
9 38—Out of chair 12 seconds	Bird touched, apparently not with trumpet.
9 40—Out of chair 6 seconds	Bird touched on top of head
9 42—Out of chair 9 seconds	No phenomena Recovering trumpet?
9 43—Out of chair 5 seconds	Trumpet voice
9 45—Out of chair for 6, 9 and 5 seconds, in quick succession	Trumpet voice
9 53—Momentarily out of chair	Tapping on trumpet or other object
9 55—Out of chair 1 second	No phenomena
10 00—Out of chair 5 seconds.	Trumpet voice
10 17—Out of chair 18 seconds	Houdini touched
10 21—Out of chair 14 seconds	Trumpet moving about throughout interval
10 32—Momentarily out of chair	Trumpet in motion

The medium could reach the trumpet without leaving his chair but with an effort with it in his hand he could touch all the sitters without effort Measurements taken with extreme care Friday morning verified all this Much of what occurred on Monday would not have called for his leaving the chair every now and then we got something especially the voices which apparently would—this if he were doing it himself, of course With trifling exceptions nothing took place at any sitting save when conversation or song were active The medium and his friend were eager to have me describe the phenomena of other mediums I had seen more than once such a narrative was broken at the climax by a voice or a touch

Mr Walker found himself touched on the hand, and was able to note that the contact was warm giving the impression of human flesh When the contacts were cold, they were usually hard enough to suggest the trumpet.

On commencement of Monday's seance, Mr Smith assured himself that it was thoroughly understood and agreed that no light was to be flashed unexpectedly. Since the medium does not go into trance nor apparently into any other abnormal or hyper-sensitive state to judge from his conversation during the seances, this seemed extremely suspicious. As always, we were warned not to cross our legs.

Seance etiquette is to greet the spirits when they arrive, and to ascertain from time to time whether they are present. At the present seances this was done with undue frequency and in a curiously uniform fashion Perhaps fifty times, perhaps a hundred, Mr Smith exclaimed "Welcome, friends"—just that, nothing more, and never any variation. In about half the cases the medium remained silent; in the other half he reinforced the query. In doing this, he invariably used the phrase "Is anybody here?" The multiplicity of control points in the same obvious direction, a question that can mean but one thing with a single control, may acquire nine different meanings when addressable to any one of the nine different "spirits." No attempt was made to de-code any of them, or of numerous other actions on the part of the medium and his friend that might have been signals.

Repeatedly through the seances the medium or his friend would ask for some specific manifestation. They never got it When the request came from one of the other sitters, however, it was met in a fair percentage of cases This looked as though it might be an overdone attempt to give the appearance of innocence

The medium always spoke up from his chair after any phenomenon—not in itself suspicious in view of the fact that he knew he was under test. Sometimes his voice came very quickly after the other voice, the touch, etc but there was never absolute coincidence Particularly he never attempted to speak from his chair while a voice was actually on. Once several sitters thought that a trace of Bert's falsetto lingered in the medium's remark that followed Bert's.

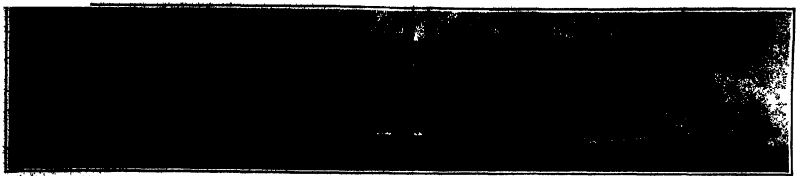
It was understood that controls were to be introduced gradually and not necessarily with the medium's knowledge, provided they could not harm him For Tuesday we adopted a device suggested by the make-up of the room We made several deep and narrow recesses between the books, and in the backs of these against the wall of the room we placed luminous-painted buttons. With the room darkened, one sitting directly in line with the narrow channel could see the buttons moving a few inches out of line obscured them entirely Buttons were placed in the line of sight from the chairs intended for occupancy by Mr Lescarboura Mr Lehmann and myself Mr Smith, however insisted upon having Mr Lehmann's intended chair, so this button had to be cut off by a book at the last moment

Early in Tuesday's sitting there was tapping on the trumpet. We had satisfied ourselves that these taps must be on the base of the trumpet rather than the top, and that the medium would have to leave his seat to produce them if he did not already have the trumpet in his possession The tapping here was preceded by the passage of an opaque object between me and my range light ditto with Mr Lescarboura. Later, when the first of the evening's psychic lights was produced, our buttons were eclipsed before and after the manifestation

About here it became clear that the spirits had picked me out as the member of the audience whom they must convince, or whom they could most easily hope to convince. For the balance of Tuesday and throughout the Thursday sitting I was the center of everything that happened Nothing notable would occur save when I was engrossed in song or story, most of what happened was actually directed at me. So I gave my entire attention to cooperating with the spirits, and left the burden of observation from our side of the room upon Mr Lescarboura's shoulders. He sat there, apparently, like a bump on a log, saying nothing—but taking everything in Perhaps he would not have looked so harmless if the medium had known that he was the designer of all the electrical apparatus employed, and of the luminous-button control as well

After he got the hang of the thing, Mr Lescarboura could predict with certainty when and where something was going to happen, by watching for his button to be eclipsed. Sometimes two eclipses came in rapid succession, indicating a quick trip out and back; sometimes they would be separated by an interval of seconds, indicating that the spook had real business in transit before he could return to the medium's chair. Always they went three in pairs; always the [illegible] of the second to follow right upon the first [illegible]

(Continued on page [illegible])



Mallett mountain freight locomotive for freight service of the Pennsylvania Railroad. Weight, engine and tender, 794,000 pounds. Tractive effort, 135,000 pounds

Three Notable Locomotives Which Mark the Trend of Railroading

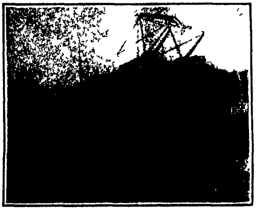
WE present illustrations of three locomotives, one passenger, and two freight, which may be taken as representing up-to-date practice in locomotive design and construction. Each is designed to meet special requirements of certain parts of the line of the railroad systems for which they have been built, and in each the object has been to secure the maximum amount of hauling power, compatible with the limitations of weight upon track, bridges and other structures of the particular systems concerned.

Among the latest achievements in locomotive development is the Mountain Type locomotive for handling heavy passenger trains, recently designed at Omaha, Neb., by the Union Pacific System. This locomotive has the slightest weight per horsepower of any as yet built in this country, which is 98.57 pounds per indicated horsepower. The reduction of weight has been secured by careful design combined with the use of high-grade material, including carbon-vanadium steel for the main and side rods. An ample factor of safety is provided, with unnecessary deadweight eliminated. An order for 55 of these locomotives has recently been completed by the American Locomotive Company for the Union Pacific System.

An indicated horsepower of 3500 has been developed at 50 miles per hour, which is a higher rating than is obtained by the Cole formula. Practically a 100 per cent boiler is provided, and no difficulty is found in maintaining the required steam pressure. Firing facilities are provided by the application of a mechanical stoker, and a power reverse gear, operated by compressed air, is used. The tender of the cylindrical type has a capacity of 12,000 gallons of water and 20 tons of coal, and is mounted on six wheel trucks. The Schmidt superheater is employed The principal data are given in the following table.

Length over couplers	90' 6¾"
Cylinders	29" dia. x 28" stroke
Diameter of drivers	73"
Weight on drivers	230,200 lbs.
Total weight of engine and tender	582,000 lbs.
Tractive power	54,838 lbs.
Total heating surface	6827 sq ft.

The majority of these engines will be used between Cheyenne, Wyoming, and Ogden, Utah, a distance of 484 miles, where heavy grades are encountered. Thus for the first 81 miles out of Cheyenne there is a steady grade with a total elevation of nearly 2000 feet, and about 10 miles of 1.55 per cent ruling grade There is also a considerable mileage of 1 14 per cent ruling grade eastbound out of Ogden In designing a single, powerful locomotive to obviate the necessity for using double headers, it was decided to build it for fast running on level or down grade sections of the line, and capable of fairly high speed on long stretches of 0.82 per cent grades when hauling heavy trains. In service, one of these locomotives can haul 816 tons at a speed of 50 miles an hour on a grade of 0.82 per cent, the locomotive developing an indicated horsepower of 3500, which gives the rate of 98.57 pounds per cylinder horsepower as noted above At a speed of 70 to 75 miles per hour, the careful counter-balancing was shown in the smooth riding qualities even at that high speed



Electric locomotive, mountain division, Pennsylvania Railroad. Weight, 240 tons. Tractive effort, 87,200 pounds

The imposing Mallett freight locomotive, which we illustrate, may be considered to be the most powerful in existence today It is true that some locomotives such as the Virginian, are larger and heavier, have a greater starting power in getting a heavy train in movement, but in the opinion of the officials of the Pennsylvania Railroad Company who designed and built it, this engine will evaporate more water and deliver more horsepower than any locomotive of which they have knowledge We think that the claim is fairly established.

The locomotive is carried by eight pairs of driving wheels, and two wheel trucks under the front frame The driving wheels are grouped in two sets of four pairs each, and they are 62 inches in diameter The total load on these drivers is 540,000 pounds, and the total weight of the locomotive is 575,000 pounds. Adding the weight of the tender, we get a total weight of 794,000 pounds. The maximum tractive effort is 135,000 pounds. The boiler is of the Belpaire type, and the barrel has an average diameter of 103 inches. The fire-box is 108 inches in length by 96 inches in width, and the total evaporating surface is 6650 square feet

The locomotive is driven by two sets of simple cylinders of 30½ inches diameter and 32-inch stroke, thus, departing from the usual practice in Mallett compound locomotive design, but a power roughly equivalent to that of compound locomotives is obtained by the use of a 50 per cent maximum cut-off, with a valve of unusually long stroke giving a quick release This half stroke cut-off has a decided advantage in point of steam consumption over a simple locomotive, having a cut-off varying from 90 to 25 per cent of the stroke, in which there is excessive cylinder condensation The boiler pressure is 225 pounds per square inch The front and rear engine frames are articulated for passing around curves by bolting steel castings between them, forming a jaw opening connected by a 6-inch pin. This device, operating in connection with powerful central springs, and thoroughly lubricated sliding surfaces, enables the entire front engine to move laterally about its articulation with the rear engine when passing around curves of 400 feet radius. It should be stated that the locomotive is fired by a duplex stoker, and that the grades are operated by a Franklin steam grate shaker The tender has a capacity of 14 tons of coal and 12,000 gallons of water

We present also an illustration of an electric locomotive, designed and built at the Altoona shops of the Pennsylvania Railroad This locomotive was built for test purposes, in connection with the decision of the company to electrify that portion of its mountain line traversing the summit of the Allegheny Mountains. The locomotive is now being experimentally tested on that part of the line which has already been electrified between Philadelphia and Paoli The principal characteristics of this locomotive are as follows

Overall length	76' 6¼"
Total wheelbase	63' 11"
Diameter of driving wheels	72"
Diameter of pony wheels	36"
Weight on drivers	196 tons
Number of driving axles	6
Total weight of locomotive	240 tons
Tractive effort	87,200 pounds

[illegible] heavy passenger locomotive for mountain grades of Union Pacific Railroad. Weight, engine and tender, 582,000 pounds. Tractive effort, 54,838 pounds

Ocean Travel by Combined Steamship and Airplane

HOW would you like to cross to Europe in a 25,000-ton, 24-knot ocean liner, whose uppermost deck consisted of a plat form 100 feet in width, and over 550 feet in length, which was absolutely free from any obstruction in the way of masts, smoke stacks, boats or other marine impediments? A promenade, such as that, would be welcomed by those voyagers who like to continue at sea the exercises and out-door recreations to which they are accustomed ashore, to say nothing of those who delight to enjoy a sun-bath, while the ocean winds have free play upon them.

Now the remarkable ship, shown in our opening-page drawing, provides just such a promenade It is able to do this, because it has been designed jointly as an ocean liner and an airplane-carrier That the plan is a practical one, is to be presumed from the fact that its designers are Sir Eustace D'Eyncourt and John H Narbeth, the former being the chief constructor of the British Navy, who is responsible for the latest ships of the British Fleet including the battle cruiser "Hood"

Our drawings, which are based upon a paper presented by the above named at the March meeting of the Institution of Naval Architects, will serve, in connection with the following digest of the paper, to make clear the purpose and main features of this remarkable design The experience gained by the naval aircraft-carriers, has proved that flying on to and off from ships at sea is rapidly becoming thoroughly practicable, "some 600 successful flights on to 'H. M Argus' and 'Eagle' have already been made, under varying condi tions of weather at sea"

The paper goes on to suggest, that we are now advancing to a position where the aircraft-carrier will become relatively quite an important ship for the Mercantile Marine, and that ship-owners, when that happens will be prepared to adopt a new type of vessel of this class for commercial purposes.

So far back as the air conference of 1920, it was suggested, that it might be practicable to carry aircraft on mail steamers, and the subject was also approached from the standpoint of a supplementary naval service, an outline design having been prepared at that time for an aircraft-carrying mail steamer. The plans herewith presented, represent the result of further investigation, since that date. This design, it should be understood, is to be regarded not as a supplement to the naval service, but as a special development of the Mercantile Marine. As a matter of fact, the proposed vessel, besides providing all the facilities of a mobile airdrome, will afford ample deck space for accommodations of all kinds, and particularly an enormous open upper deck available for recreation, besides large protected areas on the next deck beneath it Although the ship is much smaller than the "Mauretania,' the cabin accommodation is about 80 per cent of that for the "Mauretania's" for first and second class and 40 per cent for third class.

The idea of the airplane serving as handmaid for the merchant ships, has already been developed. Passengers occasionally leave London, or Paris, by airplane, after the mail train has started, and catch the boat at the English Channel port with a considerable saving of time This advantage will ultimately be increased, for the airplane, instead of alighting on a land airdrome, could fly right on to the ship herself after she had left her pier Should this be practicable, flying on and off ships at sea opens up great possibilities for air and steamer service.

Referring to the drawings, the upper or flight-deck, which is entirely free from obstruction, finishes off practically square at a position 100 feet aft from the bow There is a foremast to carry the navigation lights, also several derricks for the hoisting of cargo, aircraft, stores, etc Machines rise so rapidly from the deck, and so soon become manœuverable, that the presence of this forward mast would not be objection able to airmen The deck below is more or less open to permit some flow of air along the underside of the flight deck, thereby assisting to give a uniform flow of air above the flight deck. At the forward end of the deck is the navigation bridge with officers' quarters. Astern of these is a block of twelve life-boats, a lift serving the forward hangar; and then a second set of 12 lifeboats and hangar similar to that described above.

The deck below, which runs right up to the bow, is the first cabin deck and the accommodations include everything in the way of saloons, writing rooms, and smoking rooms, which characterize up-to-date ocean liners. It will be noticed, from the cross section, that the ship is provided with bulges. Its least width is 85 feet at the water line, from which the topsides flare outwardly to the upper deck. The adoption of bulges enables a very broad vessel to be built, without involving that excessive initial stability, which causes quick and jerky rolling. As a matter of fact, the bulges and the bilge keels will assist to make the ship very steady at sea.

The number of aircraft which can be carried will, of course, depend upon their type and construction; but it will be possible to carry in the two hangars a total of 18 to 20 fast two-seater machines, or a smaller number of large 6 to 10-seater craft.

Now, the advantages of the proposed type of vessel will be understood, from a study of the accompanying map of the Atlantic and of the Mediterranean. These are stated by the authors of the paper, as follows

(A.) Vessels running on such a service from Great Britain to New York, could send off airplanes which would reach Montreal before the steamer could get to New York. A corresponding gain would be made by Canadian steamers using the port of Halifax; on approaching Halifax, the airplane could depart before the steamer reached the port, and vice versa.

(B.) Vessels sailing between Great Britain and Australia. These vessels would run to Port Said without a stop, and on their route, could serve Lisbon, Gibraltar, Algiers, Malta and Naples by airplane. They would then run from Suez to Colombo and deal with mails for Port Sudan, Khartoum, Aden, Somaliland and possibly Bombay, while on the run from Colombo to Sydney, various other aerial services could be maintained.

(C.) Vessels running from Vancouver, Seattle, Portland or San Francisco, to Hongkong or Australia, could in the same way deal with Pacific islands and ports intermediate between those points.

Are Most Animals Color Blind?

AUTHORITIES call attention to the fact that many persons are color-blind, perceiv ing colors only in the form of varying degrees of brightness. Some have been led to believe that the same thing is true in many cases in the animal world. This variation of the intensity in light causes a corresponding reflex action in the pupil of the eye

It has also been found that apes see color practically in the same manner as human beings, dogs, cats and guinea pigs perceive colors but they are more shadowed with grey, doves and domestic fowls see red, yellow, and green just as we ourselves do, but are comparatively blind to blue. The experiments with the pupilloscope were confirmed by others such as the visibility or invisibility of food of different colors. Among invertebrate animals it was found that only the octopus possesses a pupil which reacts to light, and one authority, Carl von Hess of Munich, states that experiments with the pupilloscope indicated a most surprising correspondence of behavior between the pupil of this creature and that of color-blind persons. The instrument could not be used to examine certain other invertebrates and fishes because of their possession of compound eyes, e g, both insects and crabs have eyes of an essentially different structure which usually do not possess a pupil In such cases other experiments are employed. The experimenter found that many crabs, caterpillars and fish constantly seek the brightest portion of their containers and show themselves sensitive to the faintest degree of light perceptible to an ordinary eye On the other hand, some of the invertebrates seek the darkest part of their containers, while many ship worms retreat with lightning like speed at the least decrease of light, such as that occasioned by a passing shadow

Experiments with about a hundred different kinds of animals convinced Mr. von Hess that the general belief of the existence of a color sense in fishes, and invertebrate animals is entirely without foundation He remarks further "It was long ago observed that ants and certain crabs exhibit reactions to ultra-violet rays imperceptible to our own senses. Very recent experiments show that many insects are surprisingly sensitive to these rays. Bees, for example, whose habit it is always to go toward the light turn without exception toward a field rich in ultra violet rays. . This may explain why bees, crabs, caterpillars, etc, seem to prefer a given color in spite of being color-blind—the reason is that the said color is rich in ultra violet rays."

These new ideas are highly significant, of course, with respect to Darwin's theory of the effect exerted by bright colors in plants and animals, especially his theory of the part played in sexual selection, as when we speak of the nuptial garments of certain fishes and birds as means of attraction for the opposite sex Mr. von Hess remarks that these theories can be accepted only when three preliminary conditions are fulfilled, saying: "In the first place the mixture of rays coming from the colored organism must have the same composition as that in which they strike our own retina. Second the nervous apparatus of the animal's eye must be similar to that of the middle portion of the retina of a normal person, since this is the only part which is sensitive to color Thirdly, we must assume the animal to possess a certain amount of aesthetic sense enabling it to exhibit a preference for one color rather than another

Mr von Hess also called special attention in the case of fishes to the difference in color produced by the depth of the water, saying: "Water is never entirely colorless but usually possesses a greenish blue or blue tone even at depths of a few meters, hence the red and yellow rays of sunlight are almost entirely absorbed by it. Therefore when a fish which exhibits bright colors on land lives at a depth of 60 meters beneath the surface, as actually happens in certain cases, even an eye capable of perceiving color could not perceive the red tones which the fish shows upon its sides when brought to the surface. Again, certain creatures living more than a thousand meters under water are most splendidly colored, though at this depth not the faintest ray of light is visible; in such cases, therefore, the theory that these colors are intended either for adornment or for warning is entirely excluded. One can easily get an idea of the transformation of color even a few meters beneath the surface of the water by looking through dark green glasses, red, yellowish red, and yellow will appear dark grey, almost black, and since these are the very colors conspicuous in the so-called nuptial coloring it is obvious that this theory of sexual attraction through color is inadmissible in all such cases."

As far as humans are concerned, observation shows that out of 100 men 96 agree in identifying or in discriminating colors, while the remaining four show defective appreciation. These latter are color-blind. This defect is about ten times less frequent in women. Color-blindness is congenital and incurable, and it is due to an unknown condition of the retina or nerve centers, or both, and must be distinguished from transient color-blindness. Fortunately, in the human it is quite abnormal, and on no such basis of frequent occurrence as appears to be the case with animals.

Reclamation of Used Lubricating Oils

A LARGE amount of lubricating oil for automobiles is now thrown away through the mistaken idea that it is not fit for further use, when the only trouble with it is that it is contaminated with dirt or diluted with gasoline.

For some time past, the Bureau of Standards has been investigating this problem and has found that by using a simple apparatus now commercially available it is possible to reclaim used crankcase oil rendering it in practically every respect as good as new

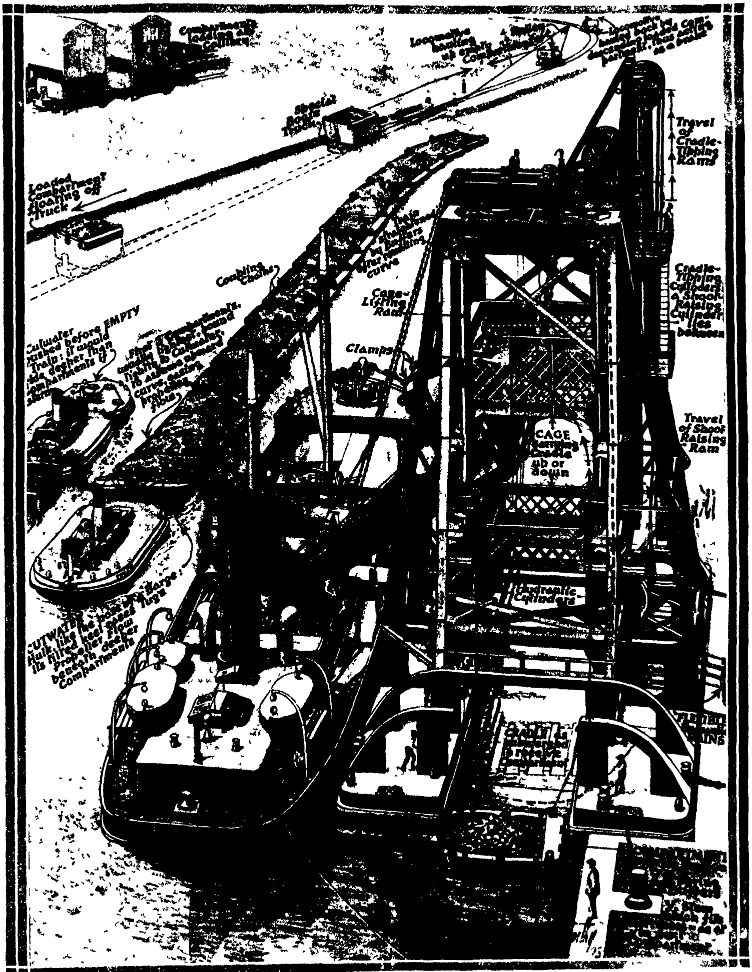
This work is described in Technologic Paper No. 223 of the Bureau of Standards which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D C., at 5 cents per copy

Acrobatic Boats for the Handling of Coal

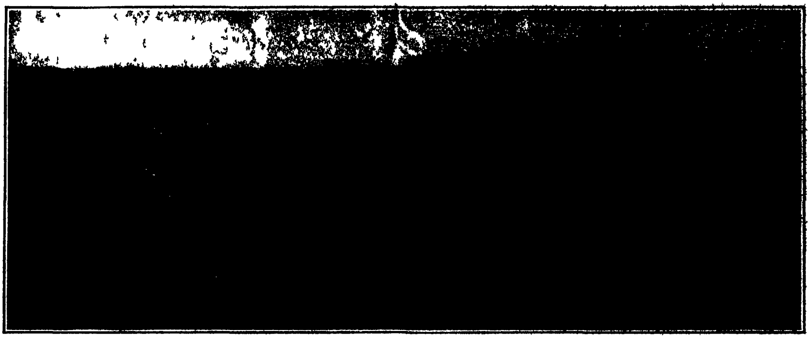
IN a recent lecture before the Institute of Transport in Great Britain, Mr W H. French described the remarkable system now in use upon the Aire and Calder Navigation Canal—a waterway which dates back to 1698—for the transport of coal from the Yorkshire collieries to the port of Goole. What are literally "boat trains," comprising up to 20 "compartments" and totaling 800 tons of coal, as depicted in the drawing on the facing page, are used, the entire 450-foot train being passed through each lock unbroken, at one "pen" or lockage. Near the colliery, which is shown in the upper left-hand corner of our drawing, the empty compartments are hauled from the water on a rail truck, the coal being dumped at the colliery screens directly into each; and the filled units then re-launched and marshalled into trains.

Arrived at Goole, shown in the foreground, each compartment in turn is shunted by the tug beneath a hydraulic hoist, which lifts and tips each compartment directly into the waiting vessel. Each compartment weighs 52 tons. If the collier is of the self-trimming type, the rate of loading is 400 tons per hour.

This train system, the invention of the late engineer, Mr W H. Bartholomew, has handled 3,000,000 tons in one year



A TRAIN OF BOATS WITH COUPLINGS AND BUFFERS, THE UNITS OF WHICH ARE PICKED UP AND SOMERSAULTED TO EMPTY THEIR CONTENTS.—(See facing page for description.)



Counterweighted lift lock for a lift of 120 feet, as proposed for the Rhine Danube Canal, showing the plateau of the Alb which has to be crossed for a distance of fourteen miles at an elevation of 1830 feet

When the Canal Barge Takes the Elevator

THE lift lock is one in which a huge tank capable of receiving the vessel to be raised takes the place of the usual stationary lock of masonry. The type is especially useful in locations where, as in the German lock here shown, a steep bluff or cliff calls for a single lift of great height.

In this design the tank and its contents are counterweighted, making necessary a massive supporting structure. Both ends of the trough and of the canal reaches are closed by double walled gates, which provide security in case of damage to either inner or outer walls. The gates are raised by electrically operated winches which are so interlocked with the main winding gear that the trough cannot be moved while the gates are open, and neither the trough nor the reaches can be opened unless the trough is in an end position and properly aligned with them.

The weight of the trough and contents is balanced by a series of counterweights arranged in groups and suspended by wire ropes. As these weights are independent of each other, each rope has to carry only the assigned load. A frame surrounding each group of weights prevents the fall of any weight. If one rope should part, the load of its counterweight would be distributed evenly among the remaining ropes. A single locking requires about 17 minutes; ascent and descent require about the same interval. Owing to the counterweights, power is required only to overcome starting inertia and friction.

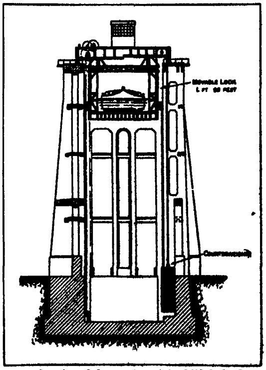
We are indebted to Demag of Duisburg and three associated German firms, the joint designers of the locks, for the illustrations, who emphasize the fact that a distinctive feature of the design is the handling of heavy loads by subdividing them and distributing them over a large number of comparatively small carrying elements. In this way details are kept within limits that have already been proved adequate and safe in actual practice, and any damaged element may be replaced quickly without disturbing the operation of the entire installation, which has been made the subject of our present cover illustration.

Tests of Welded Tanks

THE investigation of the strength of about 50 tanks, some of which had been welded by gas and some by electricity, has been completed. This work, which was carried out in cooperation with the American Bureau of Welding, was begun on December 4 and completed on February 9, and gives reliable information *on the strength of welded tanks for the consideration* of the Pressure Vessel Committee of the Boiler Code Committee of the American Society of Mechanical Engineers.

The results showed that double-V longitudinal welded seams are much stronger and more reliable than single-V welds. Recommendations were also made covering the design and construction of the heads. The pressures at which these tanks failed were so high that confidence in the safety of welded tanks, which are properly constructed, has been greatly increased. The method of testing by hammering the weld while the tank is under a pressure of one and one-half times the working pressure, was discussed. Although this test did not prove as effective in showing up defective welds as had been hoped, its use is, nevertheless, justified.

Another acceptance test proposed in this report is to increase the pressure until the shell of the tank reaches the yield point. These tests show that the tanks are safe after being tested in this way. As it is probable that tanks having large outlets would be seriously deformed and, therefore, rendered unserviceable, this test is not likely to be adopted, but an increase in the test pressure will probably result.



Front elevation of the counterweighted lift lock, showing the operating principle

It is especially commendable to note that the Bureau of Welding, which represents one of the youngest of the engineering industries, has a large number of important problems which it expects to solve. Their importance will be realized when it is considered that they effect almost every one because of the waste of material which results when designs are based on insufficient data or are influenced by prejudice, according to the Information Section of the Bureau of Standards.

Sir James Dewar

SIR JAMES DEWAR, whose death was recently announced, is popularly known to the world as the inventor of the thermos bottle. However, he was not consciously working for what is thus known, but rather for something to preserve liquid gases, with which he was experimenting. The use that his "Dewar tube" is now mostly put to came as an afterthought, not so much of his own but of the commercial world. It is true, however, that Dewar used his invention himself for such purposes, but had no intention of commercializing it. He was later able to liquefy hydrogen and he froze it at minus 435 degrees Fahrenheit. He also isolated hydrogen, helium and neon from the air. He was also the joint inventor of cordite. He died at the age of 81 years.

Spontaneous Changes in Balances

THE Bureau of Standards has just completed a careful comparison of the results of successive tests carried out on two of its highest grade analytical balances. These balances have been used constantly but with extreme care for some years. Both balances showed appreciable changes in the ratio of the arms of the beam which could not be explained as the result of wear of the knife edges. The Bureau considers that these alterations are the effect of spontaneous changes in the beam, probably caused by the gradual release of stresses set up during the manufacture of the balance. This study corroborates evidence of such changes noted in many balances of this type and supports the long-established policy of recommending that analytical and similar balances be checked occasionally by the users.

Spectrophotoelectrical Sensitivity of Argentite

SCIENTIFIC Paper No. 446 of the Bureau of Standards deals with the above subject. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

Substances which decrease in electrical resistance when exposed to light are said to be photoelectrically sensitive. Selenium is the most commonly known substance having this property.

The underlying cause of this phenomenon is not understood, although by some it is thought that this change in resistance may be caused by a change in the form of the crystal when exposed to light.

Silver sulfide possesses the property of crystallizing in two mineral formations, argentite, in which the three crystallographic axes are all equal, and acanthite, in which the axes are of unequal length, and, therefore, furnishes a ready means to study the effect of crystal structure upon photoelectrical sensitivity.

The results described in this paper are instructive in showing that the form of the crystal affects the resistance change, but it is not the underlying cause of photoelectrical sensitivity, which is connected with a grouping of atoms in the molecule. This is brought out most clearly in Scientific Paper No. 451.

Our Psychic Investigation in Europe—III

Some Details of a Very Noisy Evening with a Private Psychic Circle in London

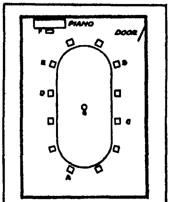
By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary of the SCIENTIFIC AMERICAN Psychic Investigation Committee

FOLLOWING a week-end at Crowborough with Sir Arthur, came a seance on the evening of March 5, which in some respects was the most remarkable of my entire trip. I shall describe the events of this sitting first, reserving comment for the end. Also, without in any way committing myself, I shall use the very convenient vocabulary of the seance room.

The group is a private one, which has been sitting once a week for seven years. Outsiders are not ordinarily admitted, but Sir Arthur's influence opened the door to himself and his friend from America. The gathering place was the dining room of the quarters above a tiny grocery store on the outskirts of London. The extension table and a piano were the only furniture of note aside from the chairs.

Sir Arthur and I arrived last; with our coming, the proprietor put up his shutters and escorted us upstairs. Of the 13 sitters, one remained outside at the piano while the other 12 formed the conventional circle about the table, with hands joined throughout. There was no medium in the usual sense; nobody went into trance, or stood out otherwise above the general level, save that most of the talking with the controls was done by the proprietor. Two of the regulars had to have certain fixed places at the table, and two others had to be opposite one another. We finally got located in a manner meeting these requirements and preserving so far as possible the alternation of sex. But as soon as complete darkness was attained, the control demanded that Sir Arthur change his seat. I was not certain whether a simple interchange were effected, or whether several sitters shifted one place each, so as to occupy Sir Arthur's original chair and leave another vacant for him.



A: Mr. Bird. B: Sir Arthur Conan Doyle after the rearrangement. C: The proprietor of the premises. D: The young lady who laid herself open to suspicion in connection with the movement of the circular plate. E (or D): Sir Arthur's original seat. F: The pianist. G: The circular plate, etc., in the center of the table

The arrangement of sitters and furniture

During the interval between the settling into place and the turning down of the gas I was able to take stock. Regular readers of the SCIENTIFIC AMERICAN will recall, some time ago, a full page of pictures showing the noise-making paraphernalia of stage and screen. Glancing about the table I could think only of this. There was a most amazing array of apparatus scattered about, and clearly we were to have a noisy evening. Two tin-horn "trumpets," a small and a large bell of the type that is rung by shaking in the hand; a mandolin; a drum, one head being of membrane and the other of tin; drumsticks; a good sized wooden mallet, a rather large four-legged stool, a wooden whistle; a thick pad of paper and a couple of prodigious pencils—caricatures upon pencils; an electric lamp assembled with its battery in a small wooden case, with red cloth stretched over its eye; a small slate, phosphorescent-painted on one side—this was all on top of the table. Underneath on the floor stood a music box; and suspended in a loose loop from the leg of the table to a point on the under side of the table-top was a strip of leather carrying a string of sleighbells.

As we took our seats in the full gas-light the sleighbells rang loudly. Hymns were sung to the accompaniment of the piano; after a little of this the gas was put out and a lighted candle set in the center of the table. After more hymns in the semi-darkness, gentle raps were heard on the table. Questions were asked orally by the sitters, or remarks made, and answered by the raps: two raps, no; three raps, yes; four raps, good night. Shortly a high, shrill, piping voice was heard; I wasn't sure where the trumpets were, but had no doubt it was one of them. This was Iris, the control—a little girl, an exotic of some sort. She indulged in violent, prolonged and disagreeably shrill laughter at all times. She talked loud and fast and freely, with the circle joining unrestrainedly in her laughter at her own jokes and theirs—of which there was a great deal. Sir Arthur thought it would have been impossible for a human voice to maintain consciously throughout the seance the shrill tone of Iris' voice.

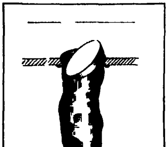
Iris demanded that the light be dispensed with, and we sat in total darkness until almost the end. I need not describe in sequence or in detail the noises that ensued. Every sound that could conceivably be produced on the instruments I have catalogued we had, and had repeatedly throughout the sitting. Few of these were musical; most were distinctly unpleasant. The most ear-splitting were when the music-box was lifted and dropped, when the stool was banged violently on the table, and when Iris put forth her best effort on the whistle. The entire evening was one prolonged riot.

Though Iris ran the seance, two other identities took part: John the rapper and Bell, the violently noisy member. It was for the special delectation of Bell that the tin drum head had been provided. He used it freely and also dealt the table some fearful blows with stool and mallet. Save that the sleighbells were apt to go off at any moment, and perhaps also with an exception in favor of the raps, I do not recall that two pieces of apparatus were at any time in simultaneous operation.

No attempt was made to receive messages of significance; the gathering with the spirits was wholly a social one. But the noises were by no means all that happened. Iris wrote on her pad messages for Sir Arthur and myself. One could hear the pencil scratching over the pad, but could not locate this on the table. The completed message was torn off and thrust into the hand of the addressee. I had no sense of physical contact and no other direct impression that this was done by one of the sitters. My message read: "Dere Mr. Bird, me is very pleased to meet you here tonight. Me thought you would like a few words from me. Iris." The letters were characteristically a child's script. The lines ran eccentrically, two of them actually interfering, while the margins at both sides were highly irregular—all as one might expect if a human were writing in the dark.

Iris could see better in the dark with the trumpet than with the pencil. Her best stunt with this was passing it back and forth across the table, touching Sir Arthur and myself in rapid alternation, and with good accuracy, upon our left hands. We were directly opposite one another, the long way of the table. The successive contacts as marked by our exclamations were very close indeed—but the fact that two trumpets were on the table made it out of the question to accept the demonstration as proving anything.

Iris later gave an exhibition of her tugging ability. She brought the big end of the horn to me so that without releasing my neighbor's hand I could grasp it with thumb and finger. She pulled vigorously and with intelligence, for when she found herself unable to take the horn away from me by straightaway pulling, she twisted it very neatly out of my grasp.



Section through the center of the table at the point where the apparatus for the final act of the seance was located. The circular plate is shown in perspective tilted up in its seat. The bag was fastened to the table clear around the hole as indicated. The exact amount of the bag dragging on the floor and holding the bell is not known

The setting for the final act of the seance

The red-screened lamp had a switch for turning it off and on, which was quite stiff—not really difficult to throw, but requiring a distinct push. While the lamp rested on the table, Iris played freely with this switch, turning the lamp on and off repeatedly. Then she began to move the lighted lamp about the room, back and forth and up and down, over the table and the heads of the sitters, in and out of the circle, smoothly and without any jerk, through wide sweeping curves and figures-of-eight covering a large range of territory. This went on for some time; to the best of my recollection the lamp was never turned off or on while in motion. It would appear somewhere at rest; it would travel about for a moment; it would then come to a stop and be turned out again, or perhaps left burning.

The request was made that Iris materialize her hands, and she agreed to do what she could in this direction. After an interval the slate was held up vertically, and a hand was seen in shadowy silhouette against the bright ground of its phosphorescent surface. The fingers were too thin for a human hand and too small, and they were quite ill shaped. Iris did not think that she could do any better than this, but under urging she went on, and presently announced that she was going to be able to make material contacts with her hands for Sir Arthur's and my benefit. Presently Sir Arthur felt the touch of a finger-end upon the back of his hand; then it came to me. Here his observations and mine were not in agreement. He found the finger firm but soft and velvety. It seemed to me that this verdict must be the result of auto-suggestion built about the expectation of a child's finger, for the finger that touched me impressed me as quite warm and hard. Sir Arthur also got more of an impression of smallness and delicacy than I did, especially in the case of the finger nail, which we both felt quite distinctly. If nothing had been said about Iris' intent, I should have dismissed the incident with the mere supposition that one of my neighbors had touched me.

The phosphorescent slate was carried about the table (without the hand) and presented to each sitter. The smaller bell, coated inside with the same substance, likewise made the tour of the table. Then the slate and the bell went around together, the bell being tilted this time so that its luminous parts were hidden and one could see only its dark outline against the bright slate. Though it had rung quite freely before, the bell was wholly silent on this tour.

The climax was reserved for the end. John had rapped "Good night," Iris had actually gone, and the bright light of the gas jet had been restored. I supposed the sitting to be at an end. But John had, as is his custom, remained for one final act, which I must describe in considerable detail.

In the center of the table a circular piece some 15 inches in diameter had been cleanly cut out. This piece had been preserved intact, and it sat snugly in the hole from which it had been cut, like a plug or lid, the bearing surface being a bevelled edge that was carried clear around the circumference of both hole and plug. On this bevel a hole of about a quarter inch diameter was bored horizontally into the table top, and from the edge of the circular panel a pin projected, fitting into the hole. If one is to remove the circular plate, it must obviously be withdrawn in the direction parallel to the axis of the pin. A mere random thrust from below upon the surface of the circular plate will not with any certainty displace the plate against the locking action of the pin.

To the under side of the table, all around the edge of the circular gap, had been attached a bag of heavy fabric. Sir Arthur and I examined this, finding it quite tight all around its junction with the table, as well as over its own surface. It was long enough to drag upon the floor. In its bottom reposed a large bell with a loose clapper. The idea was obvious—the bag cannot be greatly agitated without causing the bell to ring.

As we sat about the table in full gaslight, the circular plate was repeatedly and violently jerked from its seat and thrust tilted out of the hole. John was stated to be doing this. I asked, "Is that you, John?" and the plate responded "Yes" with three prodigious upheavals. One of the sitters was able to put the plate back in

its seat only by struggling hard against vigorous opposition. This business continued for five minutes or so, the motion of the plate getting weaker and less frequent all the time, when at length it refused to move any more, the sitting broke up.

So much for the phenomena produced. The entire seance, save for the preliminary sleighbells and the final act with the circular plate, was held in complete darkness, no attempt was made to impose test conditions, or even to apply tests. This prevents any serious opinion's being passed as to the genuineness of the phenomena. It must be admitted that some of them were, intrinsically, far from impressive, and that the whole sitting had a very direct turn toward comedy, horseplay and circus stuff. But it would not be fair to condemn it on that ground alone. We go to seances because we are ready to admit that perhaps there are still some things left for us to learn about the physical world around us. To justify this admission, we need only point out that to have withheld it a generation ago would have been to stop short of the wireless and the airplane. And if an unidentified force or energy is really at work, we make a very large and unjustifiable assumption indeed when we demand that it produce results which shall appear dignified, and in a fashion that shall appear dignified. Our dignity must be left behind us when we enter the seance room, along with our credulity if we be credulous, or our prejudices if we be at all inclined to err in the other direction.

WE have no space to repeat in detail the conditions for our psychic investigation, published in full in the January issue. For the general convenience, however, we repeat the vital points of this announcement.

The SCIENTIFIC AMERICAN *will pay $2,500 to the first person who produces a psychic photograph, under its test conditions and to the satisfaction of its Committee of Judges.*

The SCIENTIFIC AMERICAN *will pay $2,500 to the first person who produces, under its test conditions and to the satisfaction of its Judges, an objective psychic manifestation of physical character, other than a photograph, and of such sort that permanent instrumental record may be made of its occurrence.*

The Committee of Judges shall consist of Dr. William McDougall, Dr. Daniel F. Comstock, Dr. Walter Franklin Prince, Dr. Hereward Carrington, and Houdini the conjurer. In the event of death or other disability, a temporary or permanent substitute for any Judge may be named.

Entry must be made on or before December 31, 1924, to the Secretary to the Committee, at the SCIENTIFIC AMERICAN *office in New York.*

Either award will be made on unanimous vote of the Judges, or on a four-to-one division. Seances with any medium shall terminate and all his claims to the award be vacated upon rejection of his mediumship by formal vote of the Committee.

All the conditions for entrance, seances, etc., which are laid down in the full announcement of our January issue, are part of this offer.—THE EDITOR.

So we can well afford to admit that many of our seance results are unimpressive on their own grounds, and when they are actually funny we can laugh at them without any loss. More serious is the admission that any of our results are such that a single sitter, perhaps with a single hand, could have produced them deliberately, without danger of detection. In the case before us, the most serious obstacle to any hypothesis of extensive fraud is found by balancing human probabilities in connection with the relations existing among the sitters. Nobody, so far as I know, pays any money in connection with these sittings—not even the occasional outsider like myself. This was the one seance I had in Europe for which I did not have a charge of a guinea or more to meet. No attempt is made to gain public recognition of the circle and its results—such recognition is actually shunned, and so successfully that many British spiritists will not identify the group from what I have said about it. In the absence of any medium, we cannot suppose that fraud is committed to give anybody the sensation of being a big frog in a little puddle—there isn't any big frog in this puddle. And if we take the circle to be fraudulent in its entire membership, we must assume that it has been held together for seven years, and brought together once a week throughout that period, for the very intermittent satisfaction of imposing upon the very occasional outsider.

The joining of hands all around the circle is another consideration. Of course this does not at all prevent fraud, but it enlarges the number of sitters who must be participants in any fraud that occurs. If all that was observed could have been done by a single hand, we should require two parties to the guilty secret—the owner of the hand, and his neighbor. If both hands of a single operator were required, we should need three of the sitters in the fraud. If the reader will accept my impression that the phenomena observed would have called for the active cooperation of at least two of the sitters, at opposite sides of the table, the number of tricksters jumps to six. For money or as a casual indoor sport, one might picture half the group as victimizing the other half in this manner, but my imagination falters at the idea of their gathering every week for seven years on this basis.

The rearrangement of the sitters of course was bad. In a majority of my seances a shift of this sort has been demanded, on the ground that it would "make the psychic currents run better." I think it fair to say that this is a very suspicious circumstance, and that in the present instance it becomes doubly so in view of the described rigidity of the seating arrangements, involving no less than four members of the circle.

Of the specific phenomena, the sleighbells were the weakest. By no conceivable means could one know or guess where all the feet were when they rang. In the bargain, their action was always accompanied by a distinct thud, and a jar to the table, exactly as though a material foot had delivered a material jab upon the leather thong. By anything more manageable than a foot, it would seem that they could have been more easily rung by stroking the bells. Of course, the spiritists insist that the psychic operators take fiendish delight in imitating material effects in such style as to throw suspicion upon their own works. But those sleighbells did not ring true to me, and I don't believe they would have rung at all had they been in an inaccessible part of the room. Their ringing in the light, before any of the controls or psychic operators were present, was a grave violation of seance etiquette.

I must insert a testimonial to the pianist. Through two hours of absolute darkness he played brilliantly, and only thrice was he forced to hesitate while he found his place on the keyboard. At times he abandoned the piano for the violin. If the thing were altogether vaudeville, his contribution was by no means the least feature of the program.

The behavior of the lighted lamp was perhaps the most impressive feature of the seance. It covered far too much ground to permit the belief that it was carried in the hand of a single sitter. There was no irregularity in its motion to support the belief that it might have been passed or tossed from hand to hand. It had no wires or other permanent connections upon the end of which it might have been swung.

Like so many other things in my seances, and I am told in seances in general, the travel of this lamp went on with extreme precision. For instance, it swung from a point at the far side of the room, well outside the circle, straight toward me. Had I been leaning forward, it would have struck me squarely, it halted just a few inches short of where my face was at the moment. The very smallest assumption one can make regarding this sort of thing is that it is done by one of the sitters who, by abnormal vision or by other means, is able to locate objects in the dark as accurately and as promptly as the rest of us do in full light. There is no hesitation or exploring, no fumbling, accidental contact is never made with the heads or hands or feet of the sitters, and intentional contact is firm and accurate; and there is never the least bit of rustling, shuffling, breathing, or other indication that one of the sitters is in motion. More than any other feature of seances in general as I have observed them, this demands explanation.

In connection with Iris' fingers, the variability of observation occurring between Sir Arthur and myself is a common incident of seances—and for that matter of court rooms in which two witnesses attempt to describe the same incident. It presents a most interesting study in psychology, but its intrinsic importance in connection with the incident upon which the disagreement occurs is easily exaggerated. It casts no discredit upon this incident, one of the observers is right and the other is wrong, or more likely both are partly wrong—and that is all.

Several of the phenomena seemed to require, for their explanation on a basis of fraud, that the cheating member of the circle actually be upon the table. The tour of the table made by the slate and the bell was one of these. My best judgment was that these objects came far too close to the respective members of the circle to permit the assumption that they were handled by any one member from his seat. But here I may be wrong.

If all the wild noises were done fraudulently, there would have been demanded a great deal of activity on the part of the sitters, but beyond this there was no intrinsic reason why these noises could not have been fraudulently produced. Two or three free hands, and the thing is done. One's general impression, in the presence of a single phenomenon, would doubtless be that it was certainly done fraudulently, but when one sits for two hours, and finds all sorts of different things happening, one on the heels of another, without any direct audible evidences of fraud, one hesitates much longer to make this assumption.

The climax act with the circular plate has made this group of sitters rather famous among the leaders of spiritism in Britain, and is frequently cited as one phenomenon that occurs in the light, under conditions making fraud impossible. While it was going on, I had not examined either plate or bag—that came later, after the conclusion of the seance. I had therefore no idea, while the plate was cutting up, what evidence would be presented that its behavior was supernormal. Consequently I was watching the entire circle as closely as I could for suspicious actions or attitudes, and I found what might have been regarded as this, on the part of one of the ladies. This sitter was either in Sir Arthur's original seat or the one at its right—at the end of the seance, I was not sure which seat he had occupied at the beginning. Throughout the time when the plate was in action, she sat in a curious sideways position, as though trying to extend her foot under the table further than her normal reach would permit. At the same time her body was bent slightly forward, while her head and eyes behaved as though she were peering surreptitiously under the table. I was satisfied that either she was implicated in the movement of the table, or else was trying to see for herself what was going on under the table. Either hypothesis would have met exactly her position and behavior, between the two I was quite unable to choose.

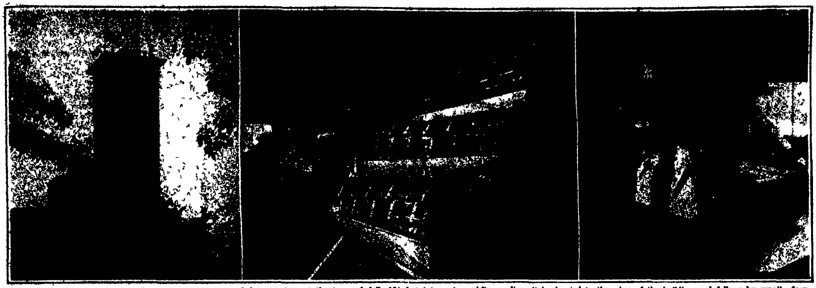
When I finally examined the layout under the table, it seemed clear that the lady, unaided, could not have produced the results observed. That the bag was really tight I am confident. There would remain the possibility of a mechanical connection between plate and table, but the plate offered keen resistance to being replaced, while so far out of its seat as to make this seem improbable. The bag, I am reasonably certain, could not have been air-tight, and in any event there was no escape of air from its mouth when the plate was unseated, so application of pneumatic power must be discounted.

If the plate were displaced by direct human agency working through the bag, from outside, we should have three possibilities regarding the behavior of the bell. First, the bag might be shaken so hard that the bell might ring; but it didn't ring. Second, the bag might be so voluminous that its upper portions could be freely kicked and prodded without sufficiently raising the folds at the bottom, or dragging them along the floor, to ring the bell, but this possibility I had in mind while examining the bag, and I concluded that there was not enough of it on the floor for such a result. Finally, one of the sitters might have anchored the lower part of the bag with his foot, while another operated upon the plate through the upper part. But even for this, I was far from certain that there was enough of the bag upon the floor. The motion of the plate would have called for very violent kicking of the upper part of the bag, while the lady of the suspicious attitude would hardly have been able to put much effective weight behind a stabilizing foot.

Beyond this brief analysis of the possibilities I should not care to go, on the basis of a single observation of the phenomenon. I would urge, however, the impropriety of putting forward any argument against it, based upon its "inherent improbability" or any similar ground. We put all this aside when, by investigating psychic phenomena, we admit that maybe they do occur. After this admission, their occurrence is not a question of probabilities or of improbabilities, but one of fact alone.

On another page of this issue I have made it clear why I feel that the issue of fraud versus genuine me-

(Continued on page 76)



Left: The shot tower. The molten lead alloy is dropped from a sieve at the top and falls 154 feet into water After cooling, it is elevated to the wing of the building and follows by gravity from process to process. It is given a preliminary polish and then passes over a series of sloping plates having small gaps which the truly round shot are able to jump; while the imperfect ones cannot get up enough speed to jump the opening. *Center* Assorting for size. The revolving screens are continually traversed by rollers which keep the shot from remaining wedged in the screen *Right:* After the shot have been assorted they are given a final polish and bagged for shipment

From beginning to end of the process of making shot there is no need for the workmen to touch the shot. Each of the several processes is done by machine and gravity carries the shot from stage to stage

Mathematically Perfect Balls of Lead Called Shot

If the end of an ordinary shotgun shell be uncrimped, out will roll scores of shining shot, beautifully burnished, perfectly graded as to size and absolutely round. Without these prerequisites the hunter will have just cause to complain of the charge of shot in the shells he uses. If the individual pellets are out of round, or if they vary in size, he will return from the hunt with less game in his shooting jacket, regardless of how good a shot he is, than he otherwise would. And a charge of shot, fired under test conditions at a prepared target will show up the cause of the disappointment The pattern will be less perfect, many of the bullets having fallen short because their imperfection results in a lower velocity through the air than the average of the charge, while others are diverted from the theoretical course because they are not round.

To produce, day after day, year in and year out, shot that are truly alike, true to gage, round, equally burnished and equally hard because of identical composition and identical methods of production has required the perfection of a process, which, far from being merely the dropping of a lot of melted lead from a sieve into cold water, is highly specialized from start to finish, involving the previous manufacture for the purpose of a whole family of special machines and the training of a special force of mechanics in traditions of care and accuracy The descent of drops of molten lead from a high tower into water, although an ancient method of making shot, is still retained, but only as the heart of a lengthy but modern scientific process. With it is retained the ancient shot tower, and it is one of these structures, a landmark on the skyline of New Haven, Conn., which contains all the special machinery that turns lead and antimony, in varying proportions according to the degree of hardness desired, into 50 tons of shining pellets every working day

From the time the molten lead pours from the big cauldrons in the top of the tower until the shot is delivered over the counter in the shell it is not touched by human hands. The whole chain of processes is automatic. Gravity moves the product from machine to machine, and the machine does all of the work.

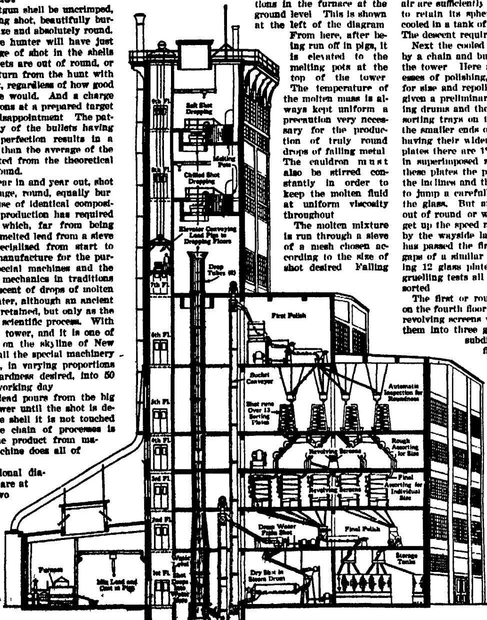
As shown in the cross-sectional diagram of the shot tower, there are at its top two melting pots and two drop tubes. The significance of this is simply that two kinds of shot are provided for, the chilled and the soft or drop shot These varieties are made by using different percentages of antimony with the lead. Otherwise the two are made in exactly the same manner. Therefore in our description we shall omit the lower melting pot and follow through the manufacture of drop shot from the upper of the two cauldrons. The lead is mixed with the antimony in the desired proportions in the furnace at the ground level This is shown at the left of the diagram From here, after being run off in pigs, it is elevated to the melting pots at the top of the tower The temperature of the molten mass is always kept uniform a precaution very necessary for the production of truly round drops of falling metal The cauldron must also be stirred constantly in order to keep the molten fluid at uniform viscosity throughout

The molten mixture is run through a sieve of a mesh chosen according to the size of shot desired Falling thence through a distance of 154 feet, the drops assume a perfectly round shape, and as they fall through the air are sufficiently cooled to form a crust strong enough to retain its spherical shape until the shot has been cooled in a tank of water at the bottom of the structure. The descent requires but 3 1 seconds.

Next the cooled shot are dried by heat and returned by a chain and bucket elevator half way to the top of the tower Here are begun the several finishing processes of polishing, inspecting for roundness, assorting for size and repolishing At the sixth floor the shot is given a preliminary graphite polish by two large rotating drums and then it descends by gravity to the glass sorting trays on the fifth floor Here it is carried to the smaller ends of a series of glass, fan shaped plates having their wider ends inclined downward Of these plates there are 13 in each tier and they are arranged in superimposed zigzag form As the shot roll along these plates the perfectly round ones run freely down the inclines and the speed thereby gained enables them to jump a carefully adjusted gap at the lower edge of the glass. But any individual shot which is slightly out of round or which is imperfect in any way cannot get up the speed necessary to make the jump and falls by the wayside later to be remelted The shot which has passed the first gap must, however, pass 12 more gaps of a similar nature, corresponding to the remaining 12 glass plates. At the end of this series of 13 gruelling tests all the shot is considered to be perfectly sorted

The first or rough sorting for size now takes place on the fourth floor Here the pellets are passed through revolving screens which are perforated in order to sort them into three general sizes, the more particular or subdivided sorting of the products of these first screens taking place on the floor below The shot is now given a final polish which adds the perfect luster which characterizes good shot, and it is thence conducted to the storage tanks.

Tests for diameter number of pellets per ounce hardness, round ness and general appearance are now made on the finished product Chilled shot being harder than drop shot, is not mutilated as much when fired from the bore of a shotgun, and therefore gives better patterns. The makers, knowing that soft shot has better killing powers than chilled shot due to the upsetting of the shot in the game, have found it necessary to have a standard hardness for each individual size of shot. The poured shot runs in size from dust to size TT, making a total of 20 sizes. But the nine sizes of buckshot are cast. There are also ten sizes of lead balls which are cast ranging from the 44 caliber to the 10 gage ball



A schematic plan of the shot tower and machinery for perfecting the shot

Where Corn Is King

Why Our Agricultural Prosperity Depends Largely on Our Annual Hundred Million Acres of Corn

By George H. Dacy

FROM the 30-acre field of corn which was cultivated and harvested by the colonists of Virginia in 1608, our annual corn production has developed and increased until now we devote more than one hundred million acres of our best land to this king of cereal crops. Both in acreage and value, corn is the most important crop that American farmers grow. According to the census of 1920 there were 6,448,343 farms in the United States and last year 76.5 per cent of them raised an average of 18 acres of corn per farm. In nine of the last twelve years, our corn crop has been worth more at market time than both our wheat and cotton crops. In eight of the last twelve years, the value of our corn crop has been greater than the combined values of all our cattle and swine produced for slaughter.

Corn, our kingpin crop, is put to many uses. The porker families which always are most numerous close to the scene of maximum corn production convert four-tenths of the American corn crop into meat and lard. Horses consume 20 per cent and cattle eat 15 per cent of what remains. Ten per cent of the crop is converted into human food, being consumed on farms and ground in merchant flour mills. Corn is also used extensively in the form of silage, fodder and stover as a feed for domestic livestock. It takes four million acres of corn annually to fill the hundreds of thousands of silos which now dot the landscape in the leading dairying and livestock districts of the country. Two million acres of corn are harvested each year by hogs and sheep that are fattened for market on the cafeteria system in these grain fields. In excess of 2,500,000 acres are cut for fodder each year.

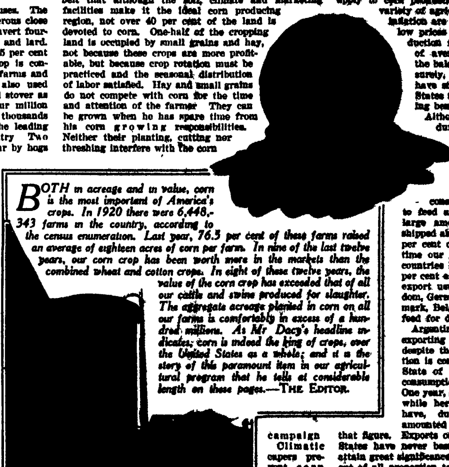
Six of our States, including Iowa, Illinois, Nebraska, Missouri, Indiana and Ohio produced 48 per cent of our entire corn crop as well as 45 per cent of our pork supply and 25 per cent of the beef which goes to feed our 107,000,000 people. Corn is king not only because it occupies more of the farmer's time and attention than other crops, but also because it is the principal source of food for the American people, either when consumed directly for human nourishment or converted into meat products. Three-quarters of the world's annual corn crop is produced in the United States. There is no other corn growing region which equals the famous American corn belt. Argentina, Brazil and Mexico grow considerable corn, most of which is consumed at home, except in the case of Argentina where the output is largely exported.

European countries raise one acre of corn to every four that are grown in the land where the Stars and Stripes are the national emblem. Among the leading foreign growers of corn are Italy, the Balkans, Hungary, Spain and Portugal. Southern France also grows some corn, while the Rumanian and Hungarian plains, most nearly approximating the American corn belt in soil and climate, produce considerable corn for home consumption and for export purposes. The people of India and Egypt grow much corn under irrigation and use most of the food locally. During the last three years, the world crop of corn has aggregated about 3,500,000,000 bushels. As the United States is the leading producer, the world output is generally abundant or short in direct proportion to production in this country.

Corn was the earliest cultivated crop grown on American farms. The Indians taught the early settlers in the Virginia and Massachusetts colonies how to plant, cultivate and harvest corn. Originally, the only tools used were crude hoes and spades. But soon the colonists introduced English plows, and from that time to this the development and use of labor-saving machinery to abet corn-raising operations has been epochal. It is notable that the Massachusetts settlers used old Indian cornfields for raising their first corn crops. They followed the primitive system of placing a fish in each hill of corn as fertilizer.

Directly after the Revolutionary War, the fertile lands of Tennessee, Kentucky and the Northwest territory were settled. Corn was raised as the chief crop and was marketed principally in the form of whiskey and fat cattle. As settlement was extended corn production developed. The perfection of the railroad aided this movement greatly and extended the available marketing points. The Civil War retarded production for several years. Thereafter corn raising boomed. About 1876, freight rates were lowered and this permitted shipping corn and fat livestock great distances at a profit. The development and extensive use of more efficient and powerful machinery, and the breeding of better strains of corn and improved methods of marketing the crop all aided in making corn the preeminent crop in the United States.

The peculiar condition prevails in the American corn belt that although the soil, climate and marketing facilities make it the ideal corn producing region, not over 40 per cent of the land is devoted to corn. One-half of the cropping land is occupied by small grains and hay, not because these crops are more profitable, but because crop rotation must be practiced and the seasonal distribution of labor satisfied. Hay and small grains do not compete with corn for the time and attention of the farmer. They can be grown when he has spare time from his corn growing responsibilities. Neither their planting, cutting nor threshing interfere with the corn



BOTH in acreage and in value, corn is the most important of America's crops. In 1920 there were 6,448,343 farms in the country, according to the census enumeration. Last year, 76.5 per cent of these farms raised an average of eighteen acres of corn per farm. In nine of the last twelve years, our corn crop has been worth more in the markets than the combined wheat and cotton crops. In eight of these twelve years, the value of the corn crop has exceeded that of all our cattle and swine produced for slaughter. The aggregate acreage planted in corn on all our farms is comfortably in excess of a hundred millions. As Mr Dacy's headline indicates, corn is indeed the king of crops, over the United States as a whole; and it is the story of this paramount item in our agricultural program that he tells at considerable length on these pages.—THE EDITOR.

campaign. Climatic capers prevent corn from being raised profitably in all parts of the country. The growing season must be at least 130 to 140 days in length. Rainfall must be sufficient and well distributed. Early frosts must not intervene to damage the corn seriously at a time when it is just maturing. The present aim of every corn breeder is to develop strains that will mature very early, as such achievements permit of extending corn raising operations farther northward. Some of the southern varieties of corn require six months of growing season, while some of those grown in the North will mature in half that time. Little corn is grown in the Far Northwest where climatic conditions are unfavorable.

Our annual corn crop is subject to as many insect enemies and diseases that the [illegible] put to it in certain localities [illegible] while. Corn smut and the [illegible] stalk and ear rots are the most objectionable diseases that prey on the corn, while such insect pirates as the chinch bug, the earworm, the white grub, the root louse, the grasshopper and the European corn borer [illegible] and quality. Smut causes a loss of about [illegible] bushels annually. No effective control has been developed. The best protection is for farmers to plant smut-resistant strains of corn which have been bred to withstand the attacks of this pest. Root, stalk and ear rots cause losses aggregating 132,000,000 bushels a year. Seed treatment, the rotation of crops and the maintenance of soil fertility are the best preventive measures against the crop despoiling diseases.

No picture of our national life and prosperity is complete unless it contains a depiction of our corn crop which is the determinate yardstick that annually measures our agricultural prosperity. The history of corn-growing is really a history of our national progress. Each is replete with the same number of successes and reverses, achievements and vicissitudes. Averages apply to corn production as they do to every other variety of agriculture or industry. Periods of inflation are followed by eras of depression; low prices succeed high values; over-production follows shortage. But the law of averages over centuries equalizes the balance and shows how, slowly but surely, corn cultivation and harvest have steadily increased in the United States to the permanent and far reaching benefit of our agriculture.

Although on two different occasions during the last decade, our annual production of corn has exceeded three billion bushels, at no time during this period have we exported more than 120,000,000 bushels in one year. Our population is increasing constantly. We have more mouths to feed at home and this prevents any large amount of our corn crop being shipped abroad. In 1899, we exported 10.9 per cent of our corn crop but since that time our yearly consignments to foreign countries have not been more than three per cent of our output. The corn that we export usually goes to the United Kingdom, Germany, Canada, Netherlands, Denmark, Belgium and Cuba, and is used as feed for dairy cattle and other livestock.

Argentina is more important as a corn exporting country than the United States despite the fact that her annual production is considerably less than that of the State of Iowa. However, the domestic consumption in Argentina is not large. One year, she exported 190,851,000 bushels, while her foreign shipments to Europe have, during recent years, annually amounted to approximately 90 per cent of that figure. Exports of Argentina corn to the United States have never been large and probably will not attain great significance unless our population increases out of all proportion to the resources of our domestic agriculture. Foreign buyers claim that Argentina corn is better than that produced in America because the kernels are smaller, making it better adapted to poultry feeding; that it is sweeter and makes a better horse feed; and that it contains 3 to 4 per cent less moisture and so will ship and keep better. Moreover, there are merchandising and international trade features which make Argentine corn more popular on the French and Belgium markets than that of the United States.

The fundamental factors that will determine the potential profits in corn production are supply and demand. [illegible]

of [illegible]. Record crops, heavy carry-over and money scarcity following the war have depressed the prices of agricultural products which are the first to reflect such internal conditions.

Through organized effort providing for storage and necessary credit, marketings of corn can be spread over a longer period in the future, and thus excessive reductions in prices as a consequence of rapid marketing at harvest time can be avoided. Farm organization of a sound, wise and far-seeing character is the key to a more prosperous and better paid agriculture. Advancement in farm organization must go hand in hand with the improvement in the distributive machinery of the country. Potentially, American farmers must adjust their production to accord with national and world demands. If the world requires less pork and beef, the corn grower will have to modify his farming to coincide with such conditions. Our increasing population will probably demand much more beef and pork and this will mean that we must increase our corn production. The extent to which meat will constitute a part of the diet of this larger population will have an important bearing upon future corn production.

The Fourth Dimension

THERE is a strange delusion that the fourth dimension must be something wholly beyond the conception of the ordinary man, and that only the mathematician can be initiated into its mysteries. It is true that the mathematician has the advantage of understanding the technical machinery for solving the problems which may arise in studying the world of four dimensions, but as regards the conception of the four dimensions of the world his point of view is the same as that of anybody else. Is it supposed that by intense thought the mathematician throws himself into some state of trance in which he perceives some hitherto unsuspected direction stretching away at right angles to length, breadth and thickness? But that is an error.

The world of four dimensions is perfectly familiar to everybody.

It is obvious to everyone—even to the mathematician—that the world of solid and permanent objects has three dimensions and no more, that objects are arranged in a threefold order, which for any particular individual may be analyzed into right-and-left, backwards-and-forwards, up-and-down. But it is no less obvious to everyone that *the world of events* is of four dimensions; that events are arranged in a four-fold order, which in the experience of any particular individual will be analyzed into right-and left, backwards-and-forwards, up-and-down, sooner-and-later.

This news that the events around us form a world of four dimensions is as stale as the news that Queen Anne is dead. The reason why the relativist resurrects this ancient truism is because it is *only in this undissected combination of four dimensions that the experiences of all observers meet.* In our own experience one dimension is sharply separated from the other three and is distinguished as time, but our experience is solely terrestrial, and if we insist on building the scheme of nature on purely terrestrial experience we are limiting ourselves to the medieval geocentric system of the world.

We must try another plan. We can never eliminate altogether the human element in our conception of nature; but we can eliminate a particular human element. If our thought must be anthropocentric, it need not be geocentric. We must leave the space-time frame entirely indeterminate. When we do that, we find that the world common to all observers—in which each observer traces a different space-time frame according to his own outlook—is a world of four dimensions. When we look at any object, say a chair, the impression on our eyes is a two-dimensional picture depending on the position from which we are looking, but we have no difficulty in conceiving of the chair as a solid object, not to be identified with any one of our two-dimensional pictures of it, but giving rise to them all as the position of the observer is varied. We must now realize that this solid chair in three dimensions is itself only an appearance, which changes according to the motion of the observer, and that there is a super-object in four dimensions, not to be identified with the three-dimensional chair in Ptolemy's scheme, or the same chair in Copernicus's scheme, but giving rise to both these appearances.—*Abstract from Romanes Lecture, 1922, by Professor A. S. Eddington.*

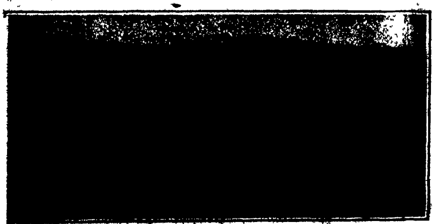
Corn is produced on a very large scale for ensilage purposes

A New Vitamin Bread

THE discovery of a newly-perfected bread is the result of extended investigations conducted by the Mellon Institute of Industrial Research of the University of Pittsburgh in direct cooperation with the baking experts and scientific staff of a leading baking company and a group of retained specialists in food chemistry.

Our corn belt produces 48 per cent of the corn crop, 46 per cent of our pork, and 25 per cent of our beef

According to Edward R. Weidlein of the Mellon Institute, there has been developed and put into successful commercial practice a method for the extraction of vitamins and mineral salts from the germ of the wheat berry. These products are used for enriching white bread in order to impart complete nutritive value and dietary balance. Dr Weidlein says that the food value of bread was formerly ascertained by chemical analysis, but that analysis fails to tell the entire story, the only accurate determination being obtained by feeding experiments on human beings or animals.



[illegible] alone our corn crop usually is worth about as much as our wheat and cotton combined

It was proved that the best white bread, if used as an exclusive diet, will not support life indefinitely. It was lacking in vitamins and mineral salts. When these were added, great improvement was noted. It was further found necessary to add milk proteins in place of water, and to balance the mineral salt constituents by the addition of the new wheat germ extract. The new bread resulted, and it is claimed that this perfected product, with only the addition of water to the diet, will sustain life indefinitely.

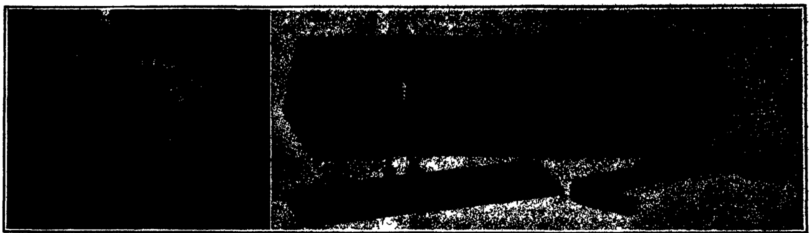
The significant part of the discovery lies in the recognition that some of our milling processes have been depriving our bread of their vitamins and mineral salts. The experience thus gained by the tests is a recapitulation of that gained by the soil expert. Until recent years it was believed that a chemical analysis of soil samples truly indicated the qualities of that soil, as well as the particular elements to be added to it in the form of artificial fertilizers. Today it is known that while such an analysis is of value in soil treatment, it is not the last word. It was often found that the addition of the elements indicated as lacking by the analysis did not produce the desired results. It is now recognized that the best way to determine what the soil needs is to experiment with the life that grows from it. If one wishes to know, for instance, whether a certain kind of soil will raise potatoes well, it is necessary to try growing potatoes on it, that is, to "ask the soil." Analogously, in finding a bread that is a complete food it is necessary to "ask the body" by trying it as a complete food. Such tests, supplemented by chemical analysis in order to check up on the exact nature of the modifications made from time to time, finally brought out the desired loaf.

Water and the Climate

EVERYONE knows how much more steady is the state of the weather on small islands at great distances from continents than in most other places. Everyone knows how much milder the climate is, how much cooler in summer and warmer in winter, at the seashore than a comparatively small number of miles inland. This phenomenon depends on the water.

How does it depend upon water? What is the effect that water exerts in that respect? There are several factors. *In the first place, it takes a great deal of heat* to raise the temperature of water, or, as the physicist says, the specific heat of water is high. If you take, for instance, a pound of water and a pound of almost anything else—there are a few substances that are harder to heat than water—and heat them over a carefully regulated flame for a certain length of time, and measure the rise in temperature, you will find that the rise in temperature of the water is less than that of the other substance. There are a few exceptions, but there are very few. The result is that an ocean or a lake absorbs heat, and does not itself rise very much in temperature.

Again, the evaporation of water takes up heat. Everyone knows that. Everyone knows that in order to evaporate water away at all rapidly you must heat it, and the amount of heat that is taken up in this evaporation of water is greater than in the evaporation of anything else, that is to say, you have got to put more heat into water in order to boil away or to evaporate, let us say, a pound of it, than you have in order to evaporate a pound of anything else. Thus the more rapid the evaporation the more effective the resistance of water to the rise of temperature, and for that reason the cooler the climate in the marine region compared with the climate in a region where there is no water to evaporate. This is one *of the most important of all economic factors* on the earth. It is a factor that, as much as any other one, perhaps, determines whether a given part of the earth is or is not really favorable for a high and active and prosperous civilization.—*Abstract from article by Professor L. J. Henderson, Scientific Monthly for November, 1922.*



Left: The recording instrument clamped to a member of a bridge truss, with its fixed and movable gage points in contact with the truss member *Right:* Interior of the recording instrument, showing the reels for the photographic recording film, the electric light for throwing the indicating beam, and the little mirror at *N* which reflects the beam to the film

The apparatus for detecting the stress actually produced in any member of a bridge with live load

When a Bridge Tells Its Troubles

A New and Ingenious Device for Measuring the Effect of Traffic on Bridges

A NEW device has been perfected by the U S Bureau of Public Roads which will determine the stress produced in any member of a bridge when a vehicle or train passes over it, no matter how great the speed. Engineers have long known how to design a bridge so that it may safely carry its own weight plus the load standing on it, but when it came to making a correct allowance for the impact which every moving load produces, they have had to estimate. The new apparatus is designed to furnish data long sought by engineers, so that in the future they will be able to prepare designs based on accurate information rather than on the mere attempt to make a liberal allowance

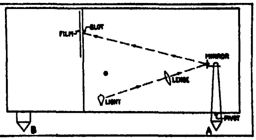
The device used, as described by E. B Smith of the Division of Tests, makes a photographic record, by means of a beam of light, of the lengthening or shortening of any part of the bridge. From the data thus gained, when the size of a member is known, the stress in it can be calculated, and by other calculations that part of the stress which is produced by impact can be determined. Such information can be used in the design of new bridges.

The design of the measuring instrument is based on an optical principle, its essential features being shown in the diagram. *A* and *B* are the two gage points, *A* being movable and pivoted as shown At its upper end is attached, by means of an adjustable fixture, a mirror By means of a small lens a source of light is focused on this mirror and is reflected back to a photographic film

In operation, any slight movement of the point *A* will rock the small mirror about its pivot, thus deflecting the beam of light and very greatly magnifying the original movement By thus using a beam of light to magnify the movements of the bridge member it is made possible to eliminate all but two moving parts, namely, the gage point with its extension and the mirror on its pivot Since the movement in either case is extremely small, these parts respond readily with very little component effect of inertia. The greater part of the magnification is obtained by the movement of the reflected beam of light, caused in turn by the movement of the mirror, and as the former takes place without any effect of inertia whatever there can be no lag or overtravel of the recording beam In order to make the instrument recording, a photographic film is so placed as to receive the beam of light which passes through a slot and makes a direct record of the variations in the bridge member on the film.

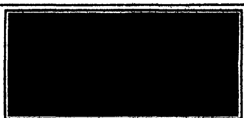
As shown in the photographs of the instrument, *L* is a small electric light whose filament is focused through the lens on the small mirror at *N* The image of this filament is reflected back across the vertical slot located in the partition of the instrument at *T* Past this slot a roll of film is caused to move and receive the record. This motion is imparted to the film through a train of worm gears, driven from a small electric motor that is run by a storage battery This battery also supplies current to light the filament.

With this instrument it is possible to get magnifications of more than 500 times the amount of the original deflection, but for most cases 300 times has been found ample. The amount of magnification is calculated by placing the device on a specially constructed block and by means of a micrometer screw, moving the gage point to a known extent and then measuring the record produced on the film.

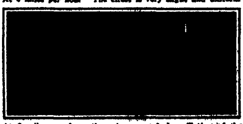


Movement of the gage point *A* with regard to the fixed gage point *B* caused by the stretching of the bridge truss member is greatly magnified at the upper end of the lever whose shorter end forms the moving gage point *A* The beam of light is focused by the lens on the mirror, whence it is thrown on the moving film, leaving a graphic record

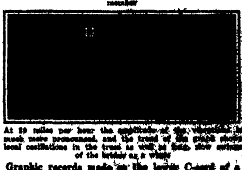
Diagram showing principle of the recording apparatus



At 3 miles per hour The effect is very slight and uniform



At 8 miles per hour there is no marked oscillation of the bridge, but the curves have greater amplitude The entire curve lies above the line, showing a slight "stretch" in the member



At 20 miles per hour the amplitude of the vibration is much more pronounced, and the trend of the graph shows local oscillations in the truss as well as fairly slow swings of the bridge as a whole

Graphic records made on the lower C-cord of a six-panel Pratt truss bridge by the passage of a 3-ton truck

Intensity and Duration of Fire

SOME experimental work has been undertaken by the Bureau of Standards in connection with investigations of the fire-resistive properties of building materials, to determine the actual fire exposures to which building constructions may be subjected as used to house various occupancies. In furnace fire tests of such constructions, they are subjected to fire exposure the intensity of which is determined according to a standard time-temperature relation, which has been thought to represent a moderately severe building fire, the duration of which will depend on the building construction and building contents, the latter being determined in a general way by the occupancy Fires of long duration and high intensity are produced by such occupancies as heavy manufacturing, merchandising, and storage, with office and residence occupancies at the other end of the scale, as giving the lowest duration and intensity

In the latest test which the Bureau has carried out a small building was constructed and furnished in such a way as to simulate an office occupancy It was then burned out in a manner calculated to approximate an exposure fire While interesting survivals of the contents of a safe were obtained, it is apparent that to be conclusive further experiments will be necessary, particularly to determine the effects of larger room dimensions on intensity and duration. Efforts are also being made to obtain an estimate of intensities of fires in buildings by examination of fire ruins. An inspection made of the Burlington Building (Chicago, Ill.) after the fire of March 15, 1922, indicated that maximum temperatures between 950 degrees and 1050 degrees Centigrade (1742 to 1922 degrees Fahrenheit) obtained generally over the burnt portion to judge by fused metals, the melting points of which were later ascertained. At a few locations the temperatures apparently exceeded these averages by about 100 degrees Centigrade

Corrosion of Engine Crank Cases

IN connection with the work on reclaiming lubricating oils, something has been done in cooperation with others interested in two examples of corrosion of engine crank cases. It has been thought for some time that the most [illegible] part of crank-case dilution was the resulting corrosion which occurred if the fuel contained too much sulfur, the sulfur being due either to that in the crude oil or in the [illegible] used in blending the fuel. In the present instance, the trouble in all probability was due to the use of fuel distilled from a Mexican crude oil which is high in sulfur. [illegible] it is known that there is a tendency toward the increasing use of Mexican crude oil. It is, of course, in the cold seasons of the year that crank-case corrosion is at its worst owing to the greater amount of crank-case dilution.

A New Gasoline-Electric Freight Train

THE "giant" freight train designed by the Austro-Daimler Motor Company, of Vienna, is made up of two vehicles: first, the engine car or tractor, carrying the gasoline-electric set for generating the electric energy required for propulsion and for controling the train service; second, a trailer, destined to receive the useful load.

The tractor, which itself carries no useful load, is a double-axle vehicle fitted with a 150-horsepower water-cooled six-cylinder gasoline engine, rigidly coupled to a 90-kilowatt continuous-current dynamo, as well as with all accessories such as electric lights, starter, auxiliary carburetor, etc., and a capstan installed at the rear end of the tractor. In addition to a self-acting vacuum brake, the vehicle carries a hand-operated brake. The rear wheels are driven from two electro-motors, each of about 15 horsepower The tractor is designed for traveling both on the road and on rails—on standard-gage tracks as well as on the wider Russian tracks.

The trailer carries its considerable useful load of 25 to 30 tons distributed over four axles in order to insure an axle pressure as low as possible. All eight wheels are driven by electro-motors, thus warranting the tractive force required The trailer mounts both a self-acting vacuum brake and hand brakes, thus insuring safe braking of considerable loads on gradients. The four-axle trailer is made up of two pairs of single-axle bogies connected together by horizontal joints and constituting the front and rear cars respectively, which, in turn, are joined by a girder The weight of the tractor is about eight tons, that of the trailer about 15½ tons. The maximum traveling speed of the train on level hard roads of medium quality is about 10 kilometers per hour and its maximum climbing capacity is a grade of 23 per cent All these data are relative to full-load operation.

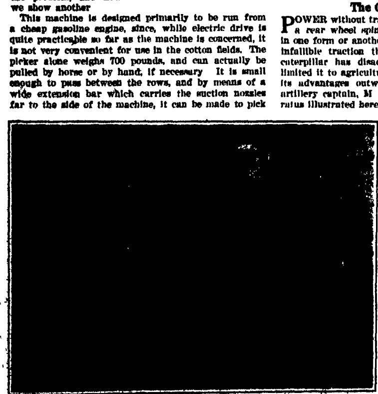
Separate views of the tractor and trailer of the new Austrian gasoline-electric road train

Another Cotton Picker

AMONG the inventions of the past few years have been several cotton pickers of unusual promise. That it has always been necessary to pick cotton by hand is well known, as are the enormous economies and the expanded production that would result from a completely successful machine picker We have illustrated one or two recent attacks upon the problem, and now we show another

This machine is designed primarily to be run from a cheap gasoline engine, since, while electric drive is quite practicable so far as the machine is concerned, it is not very convenient for use in the cotton fields. The picker alone weighs 700 pounds, and can actually be pulled by horse or by hand, if necessary It is small enough to pass between the rows, and by means of a wide extension bar which carries the suction nozzles far to the side of the machine, it can be made to pick eight or ten rows in a single trip across the field. The suction not only picks the cotton, but gathers it in bags aboard the tractor The cotton is gathered through a hose twenty five feet long, and all that the operators—one to each nozzle—have to do is to carry the nozzle to the plants and about them to the individual blooms. As fast as the operator can touch the nozzle to the cotton it flies out, passing to the bag in the tank. It is claimed that four operators on the nozzles and a fifth on the machine to take care of the air supply can gather at least 5000 pounds of cotton a day

A powerful suction rotary pump is used, handling a large volume of air at low vacuum. Two tanks are employed, so that air can be shunted from the full one to the empty one in connection with the emptying of the tank of cotton, making it unnecessary for the pickers to stop their work It is emphasized that the cotton is picked absolutely clean—that it "points out and begins to go" before the nozzle even touches it, and that there is no necessity for taking any leaves or parts of the pod The entire handling of the cotton after it is removed from the boll is taken care of, automatically, by the machine, which differs materially from others already described



Five thousand pounds of cotton in a day by five men is the claim made for this suction picker

The Centipede Wheel

POWER without traction is proved useless every time a rear wheel spins or skids. The caterpillar idea in one form or another obviously gives the most nearly infallible traction that one can hope for But the caterpillar has disadvantages which have heretofore limited it to agricultural work in heavy ground, where its advantages outweigh its drawbacks. An Italian artillery captain, M Guerrini, has perfected the apparatus illustrated herewith, designed to bring caterpillar efficiency to road vehicles, divorced from caterpillar cumbersomeness, slowness and multiplicity of parts.

The Guerrini device, in a simple and practical manner, provides any driving wheel with an anti-skid traction apparatus which has a large bearing surface and is light and easily removable It is in fact a veritable caterpillar in which the rollers, gear wheels and like parts are suppressed, and their functions performed by shoes attached to the driving wheels of the vehicle. In the case of road tractors and rubber-tired vehicles these shoes are applied by means of a belt which can be quickly adjusted and stretched over the tires, and in other cases, such as agricultural tractors, without a belt, by means of independent shoes mounted around the wheel in the way chains are sometimes mounted. We may confine ourselves to the first case since the second will be clear from it The belt consists of a certain number of links and stretching screws by means of which the assembly can be drawn tight about the wheel During the rotation of the wheel, the tires revolve upon the inner surface of the shoes, which are successively laid upon the ground. When the shoe has been replaced by the preceding one, its trunnions reach the upper end of their course raise the shoe, and turn it about so that it is ready to be planted in the ground again. At every revolution of the wheel, the shoe will first drop by its own weight against the tire, and later will be tilted forward, these two sudden displacements in opposite directions will shake the shoe and usually free it from clinging earth

Improved type of traction belt for automotive use, and (insert) a detail of the shoes and their connections

It is the system of suspension involved that is claimed to constitute a simplification of the caterpillar system Indeed the shape and proportions of the suspension are such that the kinematic couple comprising trunnions and suspension holes serves not only for placing the shoes in front of the wheel and raising them rearwardly, but at the same time for the power engagement of the wheel with the shoes. The weight of the vehicle bears directly on the top of the shoes, upon which the wheel will revolve without any sliding action, and the whole traction strain is supported by said couple and by it alone. We are obliged to omit various constructional features which have contributed to the practical success of the system The advantages claimed for the system include the following

It is applicable to all kinds of wheels, whether driving wheels or combined driving and steering wheels. Given the simplicity, ease and rapidity with which the device can be put on and removed, all motor vehicles will be able to use their highest speeds on ordinary roads, and at the same time will have at their disposal an apparatus which insures perfect adhesion and allows them to travel and work, away from made roads, upon the worst and most irregular ground The motive power is used to the maximum degree partly owing to the perfect adhesion of the driving wheels, and partly because the running loss is limited, whatever the ground may be like, to the gliding of the trunnions against the edges of the suspension holes. The use of the device reduces the wear of the rubber tires to a minimum, as they roll easily and without slipping, upon the metallic surface of the shoes.

To Disinfect East India Hides

AMERICAN tanners using British Indian hides and skins, reports Vice Consul Hooker at Madras, will be interested to learn that the installation of a hide and skin disinfection plant in Madras is contemplated by a native concern The proposed plant will be equipped to handle about 2500 skins per day The enterprise when in operating order should considerably simplify and facilitate the direct shipment of raw stock from southern India to the United States

Elevation and Range of British Naval Guns

Main Armament of Capital Ships Remains Today as Originally Designed and Constructed

By Hector C. Bywater

THE MILITARY value of high elevation in the turret guns of battleships is a subject on which considerable discussion has taken place in the United States during recent months. Public interest was first attracted to this question by positive statements, apparently emanating from the Navy Department, that British battleships of the post-Treaty fleet had, on the average, a higher angle of gun elevation than American ships, in consequence of which the former were able to outrange the latter by several thousand yards. This superiority of range on the part of British ships was due, it was alleged, to alterations made in their turret mountings since the war, or at any rate at some time subsequent to their original entry into service. On the strength of these reports Congress was requested to appropriate funds for modernizing the United States battle fleet, and particularly its turret gun mountings, with a view to enabling the ships to use their artillery at maximum range, thus annulling the advantage which the British fleet was supposed to have in this respect. After the money had been duly appropriated, the British Government announced, through the usual diplomatic channels, that no alterations of the character indicated had ever been made in the turret mounts of any ship of the Royal Navy since its completion. This categorical denial was at once accepted by the United States naval authorities, the courteous tone of Acting Secretary Roosevelt's retraction being much appreciated in England. Apparently, however, a conviction still prevails at the Navy Department that the shooting range of the British Fleet is higher than that of the United States Fleet, and accordingly it has been proposed to carry out the plan of enlarging the gun elevation of 18 ships, viz. "Florida," "Utah," "Arkansas," "Wyoming," "Pennsylvania," "Arizona," "Oklahoma" "Nevada," "New York," "Texas," "Mississippi," "Idaho," and "New Mexico"

It may therefore not be inopportune to outline some of the technical aspects of this question as seen from the viewpoint of a British naval student. Obviously it would be desirable to give all main battery guns the extreme limit of elevation practicable, i. e, the 42 deg or 43 deg equivalent to maximum range in most cases, if this could be obtained without corresponding disadvantages but it cannot. Compromise is necessary and the following remarks convey an idea of the factors governing this compromise

To glance first at earlier times. In the prolonged naval wars with France, Holland and Spain, the truck guns carried in the British fleets were given a maximum elevation of 10 deg to 15 deg, and a search through the archives reveals no complaint that this limit was insufficient. A larger elevation would have involved a deeper gun port, or else the gun muzzle would strike the top sill on recoil. A lower elevation was unacceptable for another reason. In the course of the famous English manœuver, the attack from windward, their ships were all listed by the wind toward the enemy. This circumstance greatly favored the speed with which a broadside could be fired, since the heeling over of the ship provided a natural "ramp" or incline which checked the recoil of the guns and accelerated their running-out after loading. The enemy ships, on the contrary suffered from the corresponding disadvantages. And, in the case of the French fleets, a further cause of inferiority resulted from their tactical policy, for whereas the English fired low, so as to damage the enemy's hull, the French generally fired high in the hope of dismasting their opponent. Both sides therefore required a certain elevation for their guns, but the French more than the English.

When, about the middle of the nineteenth century, the power of ordnance became too high to be controlled in truck carriages, slide mountings were introduced; the gun, on recoil, ascended a fixed sloping path and thereby expended the energy of its recoil. But great difficulties were experienced in controlling this recoil. If fired at too low an elevation the gun ran up too violently, while if fired at a high angle the downward blow on the slide was excessive. The steeper the slide, and the higher the maximum elevation of the gun, the more dangerous the blow became and the less distance the gun recoiled. Eventually it was found necessary to limit the incline of the slide to 15 deg., and the elevation of the gun to 15 deg. also. The above system was superseded, as the power of ordnance further developed, by the great Elswick invention of the hydraulic recoil buffer, which allowed the gun to recoil axially whatever its elevation. This system permitted of high elevations, which some naval officers thought desirable. When the British fleet went up the Dardanelles during the Russian crisis of 1878 there was not a single gun which could bear on the Turkish batteries, and it was fortunate for the fleet that no hostile demonstration took place. Some years later the Elswick firm designed turrets whose guns had 40 deg elevation, and several of these were supplied to the Italian Navy

But official naval opinion was in all countries opposed to accepting certain positive disadvantages for the sake of obtaining high-angle fire. The chief disadvantage was one which had operated in all stages of artillery development, with the truck gun as well as with the turret, viz., the necessity for a larger gun port. In a turret the guns project through thick armor walls, and to allow them to be elevated and depressed large elongated holes have to be cut, leaving unprotected gaps. The higher the range of elevation, the greater these gaps must be, and although they may be covered or filled by screens or sliding plates of armor, they still remain as highly vulnerable patches, "weak joints" in the armor of the gun turret. How to minimize the effect of these gun port gaps is one of the problems of the turret designer. In United States ships the trunnions are usually placed close to the front sloping armor plate. With the exception of Germany, no nation before the war paid any particular heed to this feature of maximum elevation, and even in Germany's case the interest was but transient. The turret guns of her battleships and armored cruisers of the pre-dreadnought era had unusually high elevation, 30 deg. at least, which probably gave them an exceptionally long range for their power. But when the first German dreadnoughts came to be built, their turret guns were given a maximum elevation of only 16 deg., nor was this exceeded in any of their later ships. When going over the German battleship "Baden" after she had been surrendered three years ago, I was surprised to find that her 15-inch guns could not be elevated above 16 deg. This disproved the reports which had been current during the war, that our ships were invariably outranged by the enemy owing to the superior elevation of his guns; the real truth being that in the Jutland and the Dogger Bank actions our heavy guns opened fire at ranges at which the Germans could not reply.

IN OUR April issue we exposed the falsity of the propaganda which stated that the navies were not scrapping the ships required to be destroyed by the Washington Naval Treaty. We showed that Great Britain, alone, had scrapped the eighteen dreadnaughts condemned under the Treaty and also in the four years since the Armistice had destroyed, voluntarily, a fleet of some 640 battleships, cruisers, destroyers and other auxiliary vessels. And now, from the same source, comes the statement that perfidious Albion has been surreptitiously elevating the guns of the battleships allowed her by the Treaty, with the result that the United States Fleet is today hopelessly outranged. Mr Bywater's article shows that nothing of the kind has been done, the guns remain as they were built. In an engagement, the superiority of range would at the outset be with us, because of the 34,000-yard range of two of our 14-inch gun battleships. Then the advantage would pass to her, since, with superior speed, she could hold a controlling range of 23,800 yards.—THE EDITOR.

The almost universal disregard of high elevation before the war was due to the fact that in improving the hitting power of heavy projectiles all navies were incidentally developing ranging power to an extent which was thought to be far beyond the scope of accurate fire. Battle ranges were always thought of as within the 12,000-yard limit, and as most modern big guns gave this range with a small elevation, there seemed no necessity for a greater one. The old maximum of 15 deg. was accepted as a standard.

No mystery has ever been made about the maximum elevation of British naval guns. The battleships of the "St Vincent" class, built in 1908, which first carried the powerful 12-inch Mark XI 50-caliber guns, attained a range of over 20,000 yards with their extreme elevation of 15 deg. With the adoption of the 13.5-inch gun for the "Orion" class, with a lower muzzle velocity, it was evidently found necessary, in order to maintain the required standard range, to provide for an elevation of 20 deg. This maximum angle was maintained when changing over to the 15-inch caliber, mounted in the "Queen Elizabeth" class, and with it an augmented range of over 24,000 yards was achieved. Then, during the early days of the war, the value of very high range in special circumstances was demonstrated. At the Dogger Bank action firing began at 19,000 yards; at the Falkland Islands battle the Germans gambled on getting a hit at 21,000 yards. Presumably for this reason it was decided to give the guns of the four new battle cruisers of the "Hood" class a 30-deg. elevation, corresponding to 30,000 yards. This was done, but as, at the armistice, three of the four new ships were scrapped as they lay on the stocks, only the "Hood" herself remains, carrying guns identical with those of the "Queen Elizabeth," but with the enhanced range due to 30-deg. elevation. No alteration has been made in any other British gun turret.

In the "Hood," therefore, disadvantages have undoubtedly been accepted to obtain the extra 10-deg. elevation, and it may well be questioned whether the gain compensates for them. It is obvious that, as each gun and its mount sweeps through an extra 10 deg., a deeper turret has to be provided. A longer elevating screw or cylinder is necessary, as also a larger gun port and larger sight holes. Extra power is needed to raise the heavy projectile up a steeper incline when loading at 30 deg.; and to close the massive breech—difficulties which would not, of course, arise in the case of American guns, which are understood to have fixed-angle loading. And extra stiffening may have to be provided to take the greater

(Continued on page 71)

ELEVATION AND RANGE OF UNITED STATES AND BRITISH GUNS

U S. NAVY

No. of Ships	Caliber of Guns	Length of Guns in Calibers	Elevation of Guns in Degrees	Normal Range
3 Battleships	16"	45	30	32,000
2 Battleships	14"	50	30	34,000
3 Battleships	14"	50	15	22,000
6 Battleships	14"	45	15	20,000
2 Battleships	12"	50	15	22,000
2 Battleships	12"	45	15	20,000

BRITISH NAVY

No. of Ships	Caliber of Guns	Length of Guns in Calibers	Elevation of Guns in Degrees	Normal Range
2 Battleships	16"	42	30	32,000
10 Battleships	15"	42	20	24,300
4 Battleships	13.5"	42	20	23,800
1 Battlecruiser	15"	42	30	30,160
2 Battlecruisers	15"	42	20	24,300
1 Battlecruiser	13.5"	42	20	23,800

THE question of the mechanical means by which the ancient Egyptians set up their huge obelisks, often in a court shorter than the obelisk itself, has long been a mystery. Cleopatra's Needle is 68½ feet high, 8 feet wide at base, and weighs 180 tons. An Egyptian obelisk now at St. John Lateran in Rome is 105 feet high, 9 feet wide at base, and weighs 450 tons. Still more enormous is the obelisk, never raised, which was recently unearthed lying horizontally in a granite bed at Assouan. It is 133 feet long and 14 feet wide at base Its weight is carefully estimated at 1168 tons.

It has remained for the Chief Inspector of Antiquities in Upper Egypt, Mr R. Engelbach, to suggest the above solution of the obelisk raising problem, based on references in Egyptian papyri to a sloping brick embankment or ramp 400 yards long by 35 yards wide, and the use of sand in making it, also to the known use of levers and rollers, ropes, and the employment of thousands of slaves. The obelisk was not raised, but lowered into a funnel-shaped sand-pit dug in the ramp over the spot where it was to stand It was hauled up the ramp on rollers until its base lay over the sand pit The sand was then gradually withdrawn through channels below, and as it ran out the obelisk sank into the requisite vertical position The three lower diagrams indicate, in the order shown, the sand being removed from the pit, then the obelisk coming to rest, and lastly the obelisk pulled upright This ingenious engineering idea may be typical after all, of how the Egyptians carried on much of their remarkable construction work

OBELISK-RAISING EXPLAINED: HOW THE ANCIENT EGYPTIAN ENGINEERS EMPLOYED A SLOPING RAMP AND A SAND-PIT

Industry in the Philippines

The Golden Opportunity Which this Dependency Presents to American Capital

By Vicente Villamin

THE ECONOMIC progress of the Philippines since American occupation 23 years ago far surpasses that of the three centuries preceding it. It is marked by extension of operations, greater and more standardized production, modernization of processes and more coordination in management and marketing. The development of the country on a larger scale is a challenge to enterprise.

There are 7000 islands in the Philippine group, which fact makes water transportation vital. There are 6000 miles of good roads, 6000 miles of telegraph lines and 900 miles of inter-island cables. Distant points in the archipelago are connected with Manila by radio. The outside world is reached by three cables and one wireless system. There is a tonnage of 1,300,000 engaged in ocean shipping, while the aggregate of entrances and clearances in the coastwise service is 2,000,000 tons. The foreign trade totals $250,000,000 yearly and the domestic business amounts to $900,000,000. The archipelago has an area of 115,000 square miles with a population of 11,000,000. The total wealth of the country is estimated at $5,500,000,000.

The Public Utility Commission has jurisdiction over three railroad systems, one street railway, one gas plant, 54 electric plants, eight water systems, forty telephone systems, two telegraph systems, 24 public wharves, 484 automotive vehicle lines and 138 steamers and steamship lines.

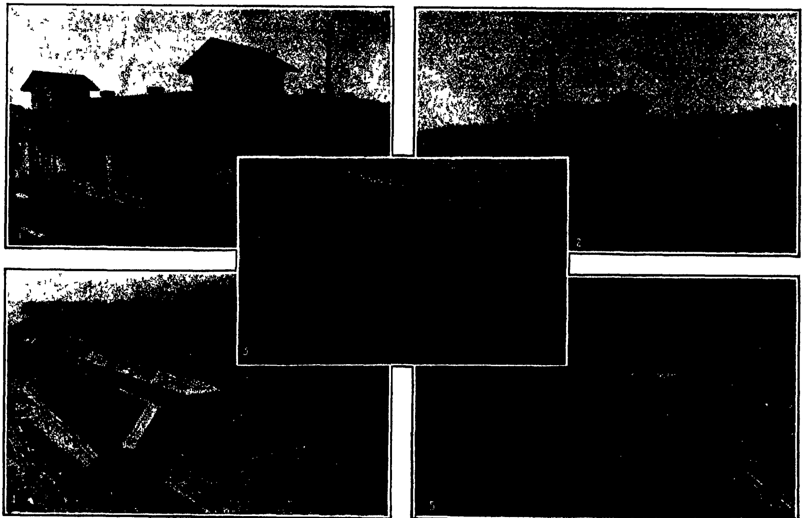
The first sugar shipment was made in 1795 when about 300,000 pounds were shipped to the United States. Development of this industry is steady but rather slow, principally due to limited capital. In 1900 the export was 65,000,000 kilos, in 1922 it was over 300,000,000 kilos. In 1920, 21 per cent of the sugar produced was 96 degrees centrifugal and 79 per cent 88 degrees Muscovado, in the following year it was 36 per cent centrifugal and 64 per cent Muscovado. As modern methods are introduced more centrifugal sugar will be produced, which means more returns.

There are still a good number of animal driven mills and small steam-power mills furnished with side-valve engines. The sugar out-turn of these mills is usually of low grade on account of discolorization by carmilization in kettles placed directly over the fire. The output of modern centrals compares well with the best of its kind in the New York market. There are now 32 of these centrals erected with a capacity of 23,000 tons of cane a day. The first central was built in 1910 on the island of Mindoro. The first shipment of centrifugal sugar, however, was made in 1914 from the San Carlos plant.

The cane goes on an endless moving platform into the crusher provided with rollers, from here the mat of cane passes to the milling plant proper consisting of a series of roller mills set in tandem. The cane fiber is then macerated by the application of water to obtain the maximum sucrose extraction, the fiber passing from mill to mill during this process. The juice obtained is subjected to a process of clarification. After being treated with milk lime to neutralize the acidity it is discharged into settling tanks to remove impurities and then decanted into the evaporator supply tank and from there pumped into cachasa tanks whence it is again decanted and discharged into filter presses. The clarified juice contains about 85 per cent water and 15 per cent solid matter. About 75 per cent of the water is removed by multiple-effect evaporators, which discharge the syrup into vacuum pans where it is boiled into crystals. Impurities remain in the mother liquor and are carried off as molasses. When the massecuite has been boiled to a proper density the contents of the vacuum pans are dropped into mixer tanks whence they go to centrifugal machines for drying. Molasses is finally separated from the crystals and the sugar is then sent to the bagging bin ready for export. The molasses is further subjected to a process of extraction, the residual molasses being used for making alcohol or cattle feed or burned for potash.

The coconut oil is expressed from copra which is dried coconut meat. In 1913 there was only one mill in the islands and the export that year amounted to 5,000,000 kilos, while in 1919 there were in operation 43 mills equipped with 296 expellers and 225 hydraulic presses from which 140,000,000 kilos of oil were shipped abroad. This material goes to the soap, margarine and compound lard industries, displacing in a great measure fats and certain vegetable oils.

After disintegrating the copra it is passed through grinders where it is converted into meal which then passes to the dryer where it is moved on belts under 220 deg. Fahrenheit for about 40 minutes, all surplus moisture escaping in a continued draft. The meal then finds its way into the oven for further tempering or cooking, being subjected here to a dry heat of about 150 deg. for 20 minutes or so, at the end of which time it goes to the expellers where it is ground by spiral screens at thousands of pounds of pressure to the square inch. The oil, laden with impurities, flows off to receptacles whence, after segregating foreign matter, it goes to filtering tanks for further clarification. From here it goes to storage tanks ready for shipment in deep



1: Car-house and main office building of the Manila Electric Company. 2: A typical sugar central in Luzon. 3: The current style in trolleys in Manila. 4: The laborers' quarters and (right foreground) the spray pond on a large sugar central. 5: Settling tanks, juice heaters and evaporators which constitute part of the machinery of sugar-cane reduction

Glimpses of the industrial life of the Philippines

sea tanks. The most important by-product of the oil is the meal which contains about 5 per cent of oil and is utilized for cattle feed in America and Europe

The Philippine copra industry is quite important There are 83,500,000 coconut trees, of which over 47,000,000 trees are in bearing, yielding annually about 1,500,000,000 nuts. In 1921 the copra production consisted of 181,000,000 kilos of sundried, 193,000,000 kilos of smoked and 1,000,000 kilos of steam-and hot air dried. Improvement in the copra drying process is badly needed to place Philippine copra on a competitive basis with that produced in neighboring countries.

A profitable industry can be developed out of the husks of the coconut, estimated to be 100,000 tons a year, for making coir mats, binder-twines and allied manufactures. Coconut shells make fine charcoal and were used in the fabrication of gas masks during the war

An industry which is hardly two years old is the desiccated coconut used in the confectionery manufacture America alone imports about 40 000,000 pounds a year This commodity is protected by a high tariff

Hemp made Manila famous. The hemp (*musa textiles*) is a perennial plant and is the most important endemic in the Philippines. The country has a natural monopoly on it, the hemp transplanted with the greatest of care in other tropical regions having produced only inferior and weak fiber Hemp was known as cordage article in 1820 when an American naval vessel took a shipment of it back to America Although it was locally known for centuries it was not until 1840 when it became an international article of commerce In 1921 over 141,000,000 kilos were exported

The stripping is done by hand with the aid of a simple apparatus invented by a Spanish priest in 1810 A great number of stripping machines have been invented and proved successful in the laboratories but found unsatisfactory for the economical extraction of the fiber under field conditions. The fibers are the fibro-vascular strands of the sheathing leaf-stalks that make up the trunk After slitting the fiber producing portion of the tree into strips, these are pulled under a knife applied to a wooden block The condition of the knife blade, the pressure with which it is pressed and the method of drying are the most important factors that determine the color and strength of the fiber

A tree produces a little over a pound of dry hemp. Two men devoting four days in stripping and tree cutting and two days in weeding and cleaning the plantation can make about 75 pounds of the best grade of hemp a week and about 150 pounds of the lower grades. The workers are generally also engaged in other callings.

Hemp is both acid- and salt-resisting and by reason of the fact that it is the strongest of hard fibers it is intrinsically worth more than what it fetches at the world's markets. It is used for marine rope, towing rope, transmission rope, oil-well cables, lariats, fine grades of binder-twine and allied products. The waste grades are manufactured into paper in Japan. A small fraction of the hemp is made into tagal braid for hats and trimmings, and in the Philippines the fiber is used in making cloth, hats, baskets and many other articles. The rope-making industry in the country has been started. In this industry one big failure has already been registered.

A COUNTRY of 115,000 square miles and eleven million people, against Cuba's 44,000 square miles and three million inhabitants, yet with its resources so untouched that its total foreign commerce in its most prosperous year was but 270 million dollars, against 820 millions for Cuba in the same year—that is the Philippines Its climate and soil quite as well suited to sugar-growing as those of Cuba, and in addition equally advantageous for the cultivation of rubber, its forests and mountains constituting a store-house of timber and mineral wealth of which Cuba could never have dreamed —this is the country whose exploitation the present author urges upon us as worth while Can we do other than agree with him?—THE EDITOR.

The tobacco industry ranks fourth among the wealth-producing activities in the Philippines, with a future that outranks all. The tobacco seeds were introduced by Spanish missionaries from Mexico in the sixteenth century In 1781 the Spanish Government established a monopoly which lasted a century The first Manila cigars arrived in America in 1818 when an American wind-jammer, the "Pequot," reached Salem with a story of an engagement with Chinese pirates which brought the ship to Manila The industry is well organized and firmly established In 1900, 173,000,000 cigars were exported, while in 1920 the number was 421,000,000. The production of cigarettes is 5,500,000,000 yearly The area planted to tobacco is 91,000 hectares yielding about 58,000,000 kilos of leaf tobacco This acreage is 39 4 per cent greater than the five-year period of 1915-1919 and 46.9 per cent than the period of 1910-1914. The land available to tobacco growing is extensive The tobacco area is inundated yearly by the Cagayan River which obviates the necessity of artificial fertilization

The fabrication of cigars is done by hand. Over 10,000 men and women are employed in the cigar factories of Manila, which look like palaces. The outputs of different factories are standardized, especially as to quality, the Government exercising the closest supervision in the factories. Applicants for work in the cigar factories undergo physical examination and employees are regularly examined the least sign of ailment is enough for the employee to be barred from the factories until he or she gets perfectly well The trade in America concedes without cavil that Manila cigars are the best moderate-priced cigar in the market and for this the close supervision is largely responsible.

The tobacco leaf from the plantation is put through a process of curing which takes about three years, at the end of which period the tobacco is sterilized It is then loft-dried and put through another curing process which lasts about four months With the exception of the stripping machine no machinery is used. It is not permissible to use molds and the system of "team work" and the use of "suction tables," which accelerate production at the expense of quality in other countries, are not known in Manila factories. Manila cigars are of clean whole tobacco, even the cheapest kind are long fillers. Scrap tobacco is manufactured into cigarettes and the rest exported.

THE prosperity of the Philippines, Mr Villamin tells us, is yet to be realized A billion-dollar trade with the United States is the aim of his compatriots As soon as the needed capital comes and the staple industries are developed, especially those of rubber and sugar, Mr Villamin feels that his native land will become one of the most important factors in world trade And his rather imposing list of Philippine industries that hold out hope for large expansion seems sufficient to justify this optimism—THE EDITOR

The commercial forests occupy about 60,000 square miles. Three kinds of lumbering are in vogue hand-sawing, water or steam mills and large steam mills, both band and circular types. American machinery and equipments are being used in an increasing degree. The industry is strictly in its infancy The United States market is just getting acquainted with Philippine woods In 1921 about 24,000 cubic meters of wood were sent abroad By actual comparative analysis the hardest and softest woods are found in the Philippines. There are varieties that make excellent railroad ties, one of them, the Ipil, has an average life longer than any creosoted tie known The lumber industry is receiving considerable attention and promises to be one of the leading industries of the country before long Measures against deforestation and conflagration are enforced strictly Lumber exports are passed upon by Government experts

Embroidery and hat industries are done by hand and exhibit the infinite patience and dexterity of hand of the Filipinos Although only half a dozen years old the embroidery industry is now worth over $7 000,000 a year, the United States market absorbing the big bulk of the output. This industry is a home industry companies located in the city of Manila distributing materials among workers in their homes in different towns and maintaining a corp of men to gather finished embroideries. Cloth is brought over from the United States, sometimes already cut up and marked, for embroidering The industry is fast developing, and considering the number of potential workers all over the Philippines, almost every woman being skilled in the work, the future of it must be limitless. The hat industry is also a home industry and is wholly done by hand work Straw hats are made out of buri, bamboo, grass and reeds and grass.

Experts have declared that the biggest gold dredging area and the richest placer grounds combined with the easiest methods in the world are located in the Philippines. One of the dredges during four and a half years' operation averaged 37 cents a yard for every yard handled which beats all the known record anywhere American equipments are exclusively used Mining and dredging companies in different parts of the Islands report progress and prosperity Silver, copper, iron and other mineral deposits are known to exist and are receiving increasing attention Asphalt is already exported, mostly to Japan Coal is being mined and it is stated that before many years the country will stop importing coal Cement plants are working and quality of output is very encouraging Several mineral oil wells have been sunk, high quality oil has been found, but the matter of its commercial exploitation is still under consideration There are large fertilizer deposits, and a couple of asbestos works are producing fair quality materials.

The rubber-growing industry is an infant one Comparative figures are very illuminating The costs per acre of rubber lands are Philippines, $51 up keep cost, $20 Sumatra $110, up-keep cost, $23, Java, $138, up-keep cost, $29 Conservative estimates of yield are 0 60 pounds for four year old trees, 2.91 pounds for eight years, and 6.22 pounds for 12 years. The Hevea rubber is what has been found to grow most advantageously in the country The rubber acreage is very small although the acreage suitable for rubber-growing is extensive. There is a strong movement in America to grow all its rubber requirements in the Philippines. The industry is valued around $250 000 000 in the primary markets

Mangrove trees yielding 30 per cent of tannin grown wild in innumerable numbers in swamps. Papain from papaya trees is obtainable which in color and activity is equal to the best in the market There are recognized about half a dozen plants as sources of medicine in standard pharmacopoeia St Ignatius bean yielding strychnine and brucine is grown only in the Philippines, while datura that yields atropine grows luxuriantly Castor oil plant, croton oil plant kamala and other plants of purgative properties grow almost in a wild state Chicle, now imported from Central America, is obtainable in the Philippines in great quantity The United States imports 8 000,000 pounds of this a year

One great industrial opening is the manufacture of paper pulp for which the raw materials are plentiful, among them being bamboo, cogon grass, abaca wastes and various palm trees. There should be a good future for bamboo soda pulp Starch producing plants like cassava, arrowroot, sincamas and yams grow everywhere Materials used in the paint and varnish industry, like copal, elemi and other terpen producing plants abound. Already there are being manufactured high-grade perfumeries from ylang-ylang, champaca, vetiver and lemon grass There is a nucleus of 40 hectares of mulberry trees yielding silk which compares well with the Chinese product in quality There is now much excitement over this industry which is believed to be another bonanza Maguey fiber of which there is quite an exportation, and rattan and willows are being developed rapidly The growing of peanut for oil has received great impetus by the steep raise of the tariff on it from foreign countries in the United States.

The waters of the Philippines teem with fish, corals and shells. There are some 50 pearling boats, mostly Japanese, engaged in the pearl fisheries The Sultan of Sulu and other Moro dignitaries are known all over the world as the possessors of beautiful pearls obtained around the waters of the island of Mindanao Soon the Philippines will not import sardines. Anchovies, sardines and the most variegated fish abound undisturbed in big schools in the limpid waters of the Philippines Shells for pearl buttons are exported to the extent of 700 000 kilograms a year

The pastoral industry is not as important as it should be there being only 1 000 000 carabaos, 800,000 cattle, 300 000 horses, 3 700 000 hogs 800,000 goats and 200 000 sheep Communicable animal diseases are prevalent all the year around They are being combated vigorously and are under control Queerly enough the country has to import about 6,000,000 dozen eggs a year from China and $5 000 000 worth of dairy products from America and Australia Cattle-raising should be one of the important industries of the country

The alcohol industry (the Eighteenth Amendment is not applicable to the Philippines) is quite important It is mostly manufactured from the sap of the nipa palm coconut tree and sugar molasses. There are around 90 registered stills producing about 10 000 000 proof liters a year There are two big breweries producing around 5,000 000 gage liters of beer a year Over

(*Continued on page 71*)

Fighting the Mosquito

How Minnows, Oil, and Drainage are Freeing Florida of a Leading Enemy of Immigration

By D. H. George

Using oil to rout the mosquitoes from the rock pits, their favorite breeding grounds

USING minnows as mosquito policemen, digging huge drainage ditches that cost from $30,000 to $50 000 apiece, fighting the minute parasitic pests with oil and State-wide cleanup activities, mobilizing every agency of modern science to eliminate a menace and peril which jeopardize the rapid settlement of the land of our last frontier—these are the effective measures that the Florida State Board of Health and manifold civic and private concerns are exercising most vigorously in freeing Florida of one of her most unwelcome guests, the objectionable, omnipresent mosquito the minute musketeer of the insect world who delights in poking his prickly bayonet into human flesh

Throughout Florida, the lowly mosquitoes that breed and swarm over regions of stagnant water have for many years acted the rôles of winged "Shylocks," ever voracious for their tribute of blood Floridans have now arisen and united resources in the most determined campaign against the pestiferous "bloodsuckers" ever waged in Dixie

The mosquito as an enemy to immigration and settlement and to sanitation and health is going to be eradicated from the land of flowers and winter sunshine before the armaments of science are again set aside Florida has initiated a State-wide drive which will cease only when the winged stingers that have been a source of disease and menace have been permanently put to flight. Although at least 40 of the 500 known varieties of mosquitoes breed abundantly within the borders of Florida only four of them are feared as obnoxious carriers of disease Of this quartet of miscreants, the mosquitoes known scientifically as the aedes tribe are the most objectionable, being the active disseminators of dengue fever—a malady which made temporary invalids of at least 20 per cent of the population of the southern States except Virginia and North Carolina last year The disease is not fatal but it enervates and weakens the patients and markedly reduces their economic accomplishments.

This same aedes mosquito is a virulent carrier of yellow fever in addition to being a foe of immigration. That is why all of Florida is now aroused and enrolled in a bonanza campaign to rout the pest The average mosquito is a semi-nautical maritime insect in that the minute fly cannot come into existence without water in which its various stages are passed Hence the leading control measure is to eliminate the water logged haunts and dens where mosquitoes may breed In a State like Florida which has more than 30,000 lakes and a coast line that covers more than 1200 miles, it appears to the layman impossible to control mosquitoes by eradicating such favorable breeding grounds. Experts report however, that by practicing such controls in the vicinities of cities the extensive disease and havoc wrought by the pestiferous fliers can be controlled practically The distance that mosquitoes will fly from their place of origin depends largely on wind and weather conditions. In the brackish water sections of the Everglades, they have been found in large numbers inland 20 to 30 miles from the coast while in New Jersey, the busy biters have been discovered as far inland as 40 miles from the coast.

Mosquitoes breed in any standing water, even that in buckets or rain barrels which are often found in the neighborhood of human habitations. The female deposits from 200 to 400 eggs at a time, which hatch out in from 20 to 48 hours. Generally speaking, from 10 to 20 days are required to complete the development of mosquitoes from egg to adult during the summer months. One interesting process in the emergence of the new crop of mosquitoes is the manner in which the "wigglers" use the old skins of their pupa stages as rafts upon which they float about until they can stretch out their wings and fly away If there is much movement of the water in the pupa stage, the mosquito will drown That is why the insects seek slow moving or stagnant water as headquarters.

The larva and pupae of mosquitoes are air breathers. They are equipped with short breathing tubes that occur in the end of their tails, which they project through the surface of the water in order to obtain air This breathing method of the mosquito permits the practice of an efficient control measure which is being used largely throughout Florida. It consists in sprinkling or spraying a thin film of oil over the surface of the contaminated water The mosquitoes are unable to push their breathing tubes through the oil film Their air supply is thus shut off and they drown and die The oiling system is most effective for treating small pools of water in ditches, ponds, streams, boat slips, crab holes, shallow lagoons, fire barrels and large containers of water. Oiling is a temporary measure and has to be practiced faithfully to secure desirable permanent results. The Florida State Board of Health has lined up the cooperation of all the garages in the State These service stations save all the oil that they drain from the crank cases of automobiles and give it to the State authorities for use in eradicating the pesky mosquitoes.

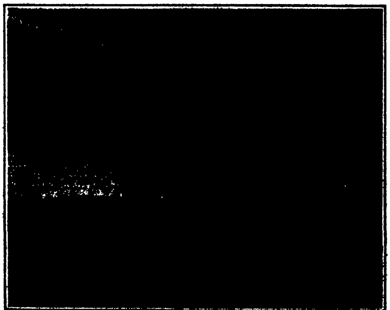
The $30,000 drainage ditch that has freed the community of Perry, Fla., from mosquito domination

According to the Floridan practices, oil is administered in knapsack sprayers, watering pots, drip barrels or cans, oil soaked sawdust or sand and by mop or burlap sticks. The knapsack spray is the most efficient and rapid distribution medium The supply can will hold five gallons of oil. The operator works a hand pump and can shoot the oil in all directions a distance of 20 feet. The method is especially efficient in oiling the edges of ditches, streams and pools. The oil drip can, placed along the course of a stream or ditch so that oil seeps constantly in the desired amount from the can into the water, is another efficacious control. The can is usually suspended three feet above the water and the hole made large enough so that from 10 to 20 drops of oil will drip out a minute.

Sawmills are numerous throughout Florida and sawdust is easily obtainable. The mosquito fighters have worked out another novel control system by soaking one bushel of sawdust in two gallons of oil for about 24 hours. The oil saturated sawdust is then "sown" over the water as one would scatter seeds over the ground In some cases, burlap bags of oil-soaked sawdust are anchored in the stream in such a manner that they emit a stream of oil for some time which is effective in killing off myriads of dangerous mosquitoes. Oil-soaked sand dumped by the cartload into mosquito-contaminated streams also aids in the abolition of the winged invaders. The sand immediately sinks to the bottom of the water while for several days thereafter, bubbles of oil rise to the surface, burst and spread rapidly

The ordinary minnow is worth $1 apiece in preying on mosquitoes. The Floridans stock streams and pools with minnows and soon the finny swimmers eradicate the obnoxious colonies of mosquitoes. It is not unusual for a minnow to consume as many as 100 large mosquitoes in a single day All that is necessary is that the water be free of lily pads, water hyacinths, matted grasses and other sources of obstruction which will prevent the minnows from penetrating to all parts of the ditch or stream.

Drainage is a permanent mosquito control measure that has proved most practical under Floridan conditions. At Perry, Fla., a community where 65 per cent of the population used to suffer from malaria, a $30,000 drainage ditch was constructed some time ago which has eliminated the mosquitoes and the source of the malarial infections. The delivery of the community of Perry from the domination of disease-spreading mosquitoes has put new life into the town and has been the commercial making of the surrounding countryside which was non-progressive during the supremacy of the mosquito monarchy.



Using the knapsack sprayer on the lawns of Miami, Fla., during the rainy season when the mosquitoes get their start. As the picture indicates, Florida's rainy season lives up to its name

Marine Wood Borers at Work

LIMNORIA is the name given by scientists to the species of marine borers to which these succulent-looking individuals belong. While the largest of these borers are only one-fourth inch long (they are shown here somewhat magnified), this rapid breeding pest is one of the most destructive of the wood destroyers found in salt water.

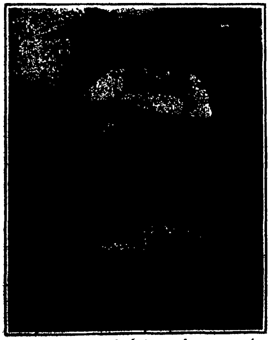
The *Limnoria* are found on both the Atlantic and Pacific coasts, subsisting on any untreated wood on which they may find lodgment, the piling in harbors affording one of their principal opportunities for existence. Coming in contact with the piling through chance of tide or drift and lodging on the surface or in crevices, the *Limnoria* start a system of interlaced burrows on the surface, eating away the softer springwood and leaving the harder wood in rib-like ridges. As the outer shell of the wood attacked is in this manner reduced to a spongy consistency, and is broken or washed away, the *Limnoria* penetrate deeper and deeper until in time the pile may be eaten almost through and snap off under its own weight.

Limnoria are especially hard to combat, owing to the fact that they will penetrate the impregnated portion of treated wood through the least crevice or abrasion and occasionally attack treated wood that may have leached out to a low toxicity.

The United States Forest Service and its subsidiary, the Forest Products Laboratory, are cooperating with other agencies in efforts to find effective chemical or mechanical treatment which will make piling immune to the attack of marine wood destroyers. This is one of the most interesting of the many fields of activity entered by the Forest Service in promoting timber conservation.

Shop-Made Lawns by the Yard

NO longer need the impatient golfer whose club is a newly organized one, or whose course has had to be renovated, wait weeks and months for the grass to grow to the point where the permanent greens may be used. Factory-made greens may now be bought by the yard, and laid down in their full velvety growth. The same service is available for grass tennis courts. A British "pro," J MacDonald, of Harpenden, Hertfordshire, has perfected a method of sowing grass seed on a special fabric in a "factory" where the temperature is always that of spring or summer. Carpets of green grass are thus produced and when these are laid down on flattened surfaces, the fabric rots away and the roots become incorporated with the soil. Lawns thus made can be played on in a very short time. Moreover, by a somewhat different method, a lawn for immediate play can be made. In this case the seed is sown into wooden trays with a fabric bottom. These can be transported in a crate and dove-tailed together, thus producing a green lawn which can even be laid down under cover. These same kind of grass rugs were employed during the World War for the camouflaging of gun emplacements and ammunition dumps.

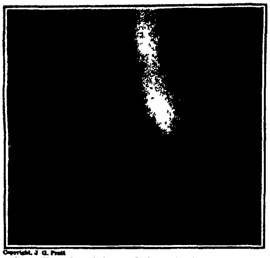


Cutting into lengths the factory-made grass carpets for golf greens and tennis lawns

How Sharp Is a Needle?

ONE often hears the expression "As sharp as a tack," or "As sharp as a razor," but in nature this would be a very poor simile, as evidenced in the accompanying photograph of a bee stinger in comparison with the point of a very fine needle, magnified through a microscope 400 diameters. At this magnification it will be noticed that the needle is very blunt and rounded, and quite crude as regards workmanship, while the stinger is perfectly smooth and *still sharp*. Further than this, something of the workmanship of nature will be realized by the fact that this tiny shaft is not solid, as it would appear, but contains a duct or interior channel through which the poison secretion is injected into the possible victim.

The poison is supplied from two sacks or glands. The one known as the acid gland is supposed to contain formic acid, the other sack secretes alkalin, and it is the mixture of the two which forms the poison. It is this poison secretion injected into the flesh, and not the puncture of the stinger, which causes the intense pain with which the most of us are more or less familiar.



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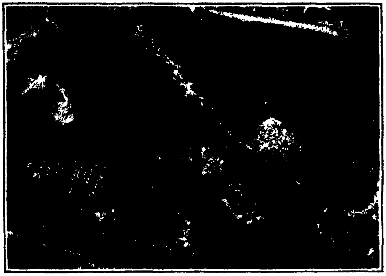
A needle point (left), and that of a bee's stinger, photographed at 400 diameters magnification to show the relative crudity of the former



The thing that makes our wharves short-lived—a colony of wood borers at work, under a magnification of about fifteen diameters

Compressibility and the Size of Atoms

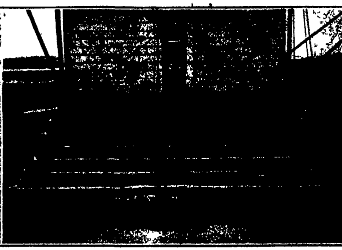
ONE of the most interesting subjects discussed at the meeting of the American Association for the Advancement of Science at Cambridge in December last was that of the size of atoms, especially as they exist in solids. Only a few years ago it was believed that the atoms in solids occupy only one-fourth to one-half the total volume at any instant, but that each atom vibrates with a high frequency in the space between the adjacent atoms available for this purpose. It was supposed that in the compression of the solid the atoms are merely forced closer together, without any distortion of the atoms themselves. About 15 years ago Professor T W Richards of Harvard University began to develop the distinctly novel idea that the atoms occupy most of the space in a solid and that in any considerable decrease of volume the atoms themselves are diminished in size. This gave rise to his celebrated theory of "compressible atoms." In 1921 Professor Richards showed that the dimensions of atoms could be calculated from the compressibilities of the solids in which they exist provided data are available for a set of compounds related to each other chemically in a sufficiently simple way. For example he obtained such data for the fluorides, chlorides, bromides and iodides of lithium, sodium, potassium, rubidium and caesium. Using an ingenious extrapolation to zero compressibility he was able to show that the values correspond to a diameter of 2.8 Angstrom units (ten millionths of a millimeter) for the chlorine atom in common salt and other similar compounds. The interesting feature of the results is that diameters of the atoms, especially those of the metals, proved to vary with the nature of the compound in which they are found. Thus the sodium atom is smaller when combined with chlorine (as it is in common salt) for which it has a high affinity, than when it is united with bromine or iodine, for which its affinity is less. Professor Richards' most recent work has been to devise a new and more directly experimental method for calculating the dimensions of atoms, with the remarkable result that the values obtained are the same, within the limits of error, as those given by the older method. The new method depends upon the idea that the element sodium, acts under compression exactly as potassium would act under high pressure. The attractive forces between the atoms is such that the internal pressure in sodium under ordinary conditions is 20,000 atmospheres higher than that in potassium. By using the data on these two elements he is able to show how the contraction which occurs in the formation of a salt from the elements may be distributed between them. The results throw much light upon the mechanism of chemical combination, the magnitude of the internal pressures involved and many allied phenomena.

The Present Conception of Matter

IT is probable that in the stars there is going on a transmutation of the elements, more complex ones being built out of the atoms of hydrogen the simplest of all, while others are themselves disintegrating. And what is going on spontaneously in the stars has actually been accomplished artificially in the last year or two by Sir Ernest Rutherford in the Cavendish Laboratory at Cambridge. Although, as yet, the total amounts of subatomic energy he has liberated have been minute, they are enormous when compared with the quantities of matter affected, but it must be added that there is no evidence that we may tap these stores of power.

It is for such reasons that during the last few years, our conception of the nature of matter has entirely changed. The nineteenth century dispelled the hazy ideas of the alchemists. New elements were continually being discovered and the more exact investigation became the more likely did it appear that these elements and those previously known were the ultimate materials of the universe. More than 80 elements became known. Mendeleeff had found it possible to arrange a periodic scheme by means of which undiscovered elements could be predicted to fill the blank spaces in the table, and subsequent discovery showed how accurately the properties of such elements had been foretold. Later on Sir William Crookes thought of the evolution of the elements from a fundamental something which he called a "protyle" a hypothesis originally advanced by Prout in 1815. But with the advent of the twentieth century came the greatest change. From many sides attacks were made on the idea of the mutual independence of the elements each of which had been supposed to possess precise and exclusive characteristics. It was shown that elements existed in which the atoms were not all exactly alike although the different specimens of such elements were chemically indistinguishable from one another. these were named "isotopes" by Professor Soddy. Lead, for example, is one of them. This substance may be obtained in several different ways. to the chemist it is always lead, but its atomic weight depends on the way in which it has been derived.

Setting the 3300-pound capstone, Dec 6, 1884. The staging is supported from the windows on each face



This view was taken when the surface soil had been removed, uncovering the original rubble stone foundation, preparatory to underpinning

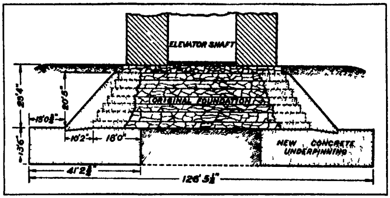
The old foundation was cut away and concrete buttresses built in, piece-meal, without any cracking of the upper masonry

Underpinning the Washington Monument

Enlarging the Foundations to Carry the Five Hundred and Fifty-Foot Shaft

IF THE Washington Monument had been built in the days of the ancients, it would have formed, doubtless, the eighth "wonder of the world" Even today, in this age of big constructions, it stands unrivaled in the class of obelisks to which it belongs

Among the millions of American citizens who have looked upon this noble memorial to George Washington, very few are familiar with the story of its erection, and we owe it to Capt D L. Weart of the Corps of Engineers, United States Army writing in the last issue of the *Military Engineer*, that the following account of the erection of the Monument had been made public The following article is based upon his most interesting story and to the above mentioned journal we are indebted for our illustrations.



Cross-section showing the walls of shaft 15 feet thick, the original foundation, nd the new concrete buttresses resting on a hollow, rectangular slab, measuring 126 ft 5½ inches on each side

The first movement in the direction of building a monument to Washington, was made in 1783, when the Continental Congress authorized the erection of an equestrian statue to be erected where the seat of Congress was established In 1791, L Enfant provided a location for the statue in his plan of the city of Washington.

Shortly after his death in December, 1799, Congress, on the motion of John Marshall, provided for the erection of a marble monument in Washington, and requested that the family permit his body to be deposited under it The subject was brought up again in 1816, and in 1819 but nothing definite was done although about this time a vault was prepared for Washington's remains beneath the floor of the crypt under the dome of the Capitol James Buchanan in 1824 and President John Quincy Adams, in 1825, brought the question to the attention of Congress but still no action was taken So much for the remembrance and veneration of Congress.

Eight years later, in 1833, some influential citizens of Washington, hopeless, apparently, of any action by Congress, formed the Washington National Monument Society with Chief Justice John Marshall as president and a campaign was started to secure funds. Three years later, designs for a monument to cost $1 000 000 were invited, and the competition was won by Robert Mills, whose plans called for a circular colonnaded building, 250 feet in diameter and 100 feet high with a 500-foot shaft raising from its center The colonnade feature was never adopted.

Twelve years later, in 1848, Congress authorized the society to erect a monument to the memory of George Washington at the present site, and the corner stone was laid on July 4 1848, at which time the society had collected $88,000 towards defraying the estimated cost of $1,000 000

The foundation conditions were found to be good. The underlying strata was very compact, and at the depth of 20 feet, a solid bed of gravel six feet deep was encountered The original foundation was 80 feet square at the base, 23 feet 4 inches deep, built in pyramidal shape with the sides stepped, as shown in the illustration It was built of blue gneiss, in blocks weighing from six to eight tons The base of the monument proper, measured 55 feet 1½ inches square, the walls at this point being 15 feet thick The first 150 feet of the shaft were built with dressed white Maryland marble, and this height was reached in six years' time, or by 1854, when work ceased for lack of funds.

Five years passed and then, in 1859, Congress passed an Act incorporating the Washington National Monument Society for the purpose of completing the erection of the monument The Secretary of War appointed Lieutenant J C Ives, Corps of Topographical Engineers, to superintend construction He examined the foundation and reported that it was entirely satisfactory Shortage of funds delayed the work, until Congress took action and appointed a committee to confer with the society This was in 1873, and in 1874, on the recommendation of Lieutenant W F. Marshall, Corps of Engineers, later Chief of Engineers, it was decided that the height of the shaft should be reduced from 600 to 500 feet, so as to avoid excessive pressure on the soil of the foundation It was not until August 2, 1876, that the thing was done which should have been done many decades before, for in that year, President Grant approved an Act which provided that the Government should take over and complete the erection of the monument, and that the Corps of Engineers should report on the sufficiency of the foundations. This board reported that the foundation was not sufficient to carry a shaft of the proposed height, and, thereupon, was undertaken the important work of underpinning the foundation, which is shown in the accompanying illustrations. This was done under the direction of Lieut. Colonel Thomas Lincoln Casey, afterwards Chief of Engineers. The trouble with the old foundation was that it was too shallow and covered an area insufficient to sustain the pressure which would come upon it when the shaft had been carried to its full height. The strengthening consisted in enlarging the foundation by spreading it over a greater area and sinking it a greater depth into the earth.

By reference to our line drawing, showing a section through the foundation, it will be seen that, except for a central space 45 feet square below the old foundation, a massive square concrete slab, measuring 126 feet 5¼ inches on each side, and 13 feet 6 inches in thickness, was built below the original foundation. Start-

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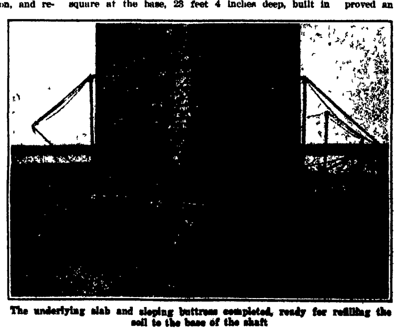

The underlying slab and sloping buttress completed, ready for refilling the soil to the base of the shaft

A Canal that Grows Crops in a Barren Country

ONE of the most curious canals in all creation is that now operated by Uncle Sam to carry the waters of the Malad River in southern Idaho to the King Hill irrigation project in the Snake River Valley. Without water for irrigation, 17,000 acres of land in that neighborhood would be practically worthless. However, with plenty of moisture available, the locality will produce luxuriant and profitable yields of every crop that can be raised in the Temperate Zone. Alfalfa, early vegetables, grain, fruit and stock are the leading money crops. Due to favorable climatic conditions, the King Hill farmers can market early vegetables from two to three weeks ahead of any of their rivals.

The water of the Malad River is diverted into the canal at a point one mile above its mouth. The water is carried 4000 feet through a large flume in the Canyon of the Malad. The main canal is 52 miles long, five feet deep and 8½ feet wide. It has four large bridges and siphons across the Snake River. Sixteen miles of the canal features concrete-lined banks, it being one of the most extensive of the western irrigation channels of a permanent nature. The Malad River is fed by springs so that it is a dependable source of water. The yield of water throughout the irrigation season which lasts 193 days is adequate. Plans are now under way to construct emergency water storages as sources of emergency moisture during abnormal seasons.

The irrigation of the Snake River Valley has not only provided homes for a great number of citizens who, otherwise, would have been unable to obtain farm homes, but it has also created taxable values in excess of the entire cost of the project. These values are of a permanent character and will endure and be a perpetual benefit to the community, State and Government. The course of the canal is very crooked and tortuous, as is shown by the fact that the waterway extends over a route of 52 miles in providing artificial rainfall to but 17,000 acres of farming land. More than five miles of wooden flumes have been replaced recently by concrete flumes and siphons. These improvements are practically everlasting, while wooden construction rots out in about ten years.

The King Hill Canal is interesting, inasmuch as after the private company that originally owned it failed, Uncle Sam took control of the water plant, spent over a million dollars in improving it and now has developed it into one of the best small water projects in the Western States. He has built and is testing out the efficiency of five different types of flume construction. They consist of wood, monolithic, gunite, gunite and concrete and concrete semi-precast construction. Thus far the last three types have been most satisfactory. Where the topography is very steep and conditions do not permit of doing the concrete work directly at the scene of flume construction, the semi-precast system of building the flumes has proved practical. The concrete slabs are made in sections 12 feet long which weigh 3660 pounds apiece and then are joined together with sections of burlap soaked in tar. Altogether more than 17 siphons have had to be built which range in diameter from 48 to 100 inches. The gunite method of construction which features the use of cement guns for the deposition of the concrete aggregate has proved particularly satisfactory under circumstances where any leakage of water which occurred might damage the foundation of the flume. The gunite flume is very durable and wearworthy despite that its walls are but 2¼ inches thick. It can be built quickly and efficiently at lower outlay and with less labor than any other type. It promises to play a prominent part in revolutionizing flume construction.

A piece of the 52-mile canal that carries the mountain waters of the spring-fed Malad River to the irrigated farms of the Snake River valley

Harnessing the California River

ONE of the latest of the California irrigation works is represented by the Don Pedro dam which was completed early this spring. The dam, which is situated ten miles above La Grange on the Tuolumne River, is believed to be the second highest irrigation and power dam in existence, overtopping the famous Roosevelt dam at Phoenix, Arizona, by several feet. It is 283 feet high, 177 feet thick at the base, 16 feet wide at the top, and 1000 feet in length. It will serve to create a reservoir covering 3276 acres, and will store 289,000 acre-feet of water and serve to irrigate 165,652 acres of what will prove to be highly productive land. Also, its waters will serve to develop 17,000 horsepower, which will be distributed among the owners of the irrigated land for application to lighting and power.

As will be seen from our illustration, the dam is being built in a series of great steps, and an interesting feature of the work is the method in which gravity is used in placing the concrete. At or slightly above the level of the crest of the dam are large mixers which turn some 2000 tons of gravel, sand and cement into 1800 yards of concrete on every working day. From the mixers miniature trains, driven by gasoline motors, carry the liquid concrete out upon the completed portion of the crest of the dam from whence it is conveyed in a series of flexible pipes down to the newly erected forms at the various levels of the finished work. A power house which is built a hundred feet up the canyon against the dam, contains three turbine generators, each capable of producing 6000 horsepower.

Within the body of the dam itself are 4300 feet of auxiliaries leading to valves which regulate the flow of irrigation water. These auxiliaries extend in four horizontal planes.

The lake above the dam will cover one of the historic spots of California's gold mine days. Don Pedro Bar, a mining town from which thirteen million dollars worth of raw gold was shipped through the Wells-Fargo express office, alone, cast fifteen hundred votes in 1860 when Lincoln was elected President. The town was destroyed by fire in 1864, and as the gold had been taken out by that time it was never rebuilt, ultimately its site will be buried under 165 feet of water.

General view of the Don Pedro dam in California, said to be the second highest irrigation and power dam in the world

Quantum Mechanism in the Atom

AT a meeting of the Royal Society of Edinburgh on May 8 Professor E. T. Whittaker read a paper on the quantum mechanism in the atom.

Professor Whittaker shows that it is possible to explain the photo-electric effect satisfactorily in terms of the classical electrodynamics without postulating any structure in the atom beyond that by which it is customary to explain induced magnetization. The author considers the effect of an approaching electron in producing a "magnetic current" in the atom, up to a certain velocity of approach the electron does not get beyond the atom but suffers an "elastic impact" which repels it without loss of energy. When, however, the velocity of approach exceeds this critical value the electron passes through the magnetic atom and gives to it energy of exactly that amount or quantum which corresponds with the critical velocity. The transformation of this energy into radiant energy can be explained by generalizing the conception, thus the magnetic current becomes equivalent to a charged condenser, partaking of the nature of a Hertzian oscillator. By a simple mathematical process, combined with the assumption that the oscillators in the atoms are similar to each other in structure and differ only in scale, the equation $h\nu = U$ can be established, giving Planck's relation connecting the frequency ν of the emitted radiation with the amount of kinetic energy U absorbed from the bombarding electron. Photo-electric phenomena can be interpreted on the basis of this theory, and Bohr's theory of series-spectra likewise finds an explanation.—Abstract from *Nature* for July 1, 1922.

1: In laying the tile it is extremely necessary that no pockets or local reversals of slope be introduced. As tile of small diameter are sometimes laid on gradients of as low as on feet, although this is unusual except in the case of large tile the accuracy of the gradient is more easily maintained by raising all the interval proper gradient is then given the cross-bars and the tile must be placed at uniform distances below it. This elevates the work from the dark, with an ordinary plow and two horses drawing from the opposite ends of a long evener 3: An endless chain type of trenching machine, with large-sized tile with the aid of an easily moved tripod that straddles the ditch

Equipment used in trenching and laying tile

Draining Land With Gasoline

How the Scarcity of Labor has Brought About the Use of Machinery for Marshland Ditching

By S R. Winters

AKING no account of vast areas of over- and swamp lands subject to the mation facilities of private and gov- ental agencies, there are 43,873,000 acres of farming lands in twenty-eight American States whose crop-producing powers could be enhanced by drainage According to sectional distribution, tile could be buried advantageously along an expanse of territory embracing 22,556,000 acres in ten Southern States, there being 6,000 000 acres of wet lands in Louisiana alone. In nine Western and Middle Western States underdrainage would quicken and increase crop yields on 12,300,000 acres, while in an equal number of Northern States trenching machinery would redound to the benefits of 8,417,000 acres.

This official computation, data hitherto unpublished, is based on an investigation made by the Drainage Division Bureau of Public Roads, which serves to heighten interest in behalf of adequate drainage as well as to emphasize the achievements already credited to modern machinery and methods in removing excess water from agricultural areas. Over against the background of the compilation relating to the vast regions in need of tile underdrainage is the encouraging accomplishment of ditching mechanism in four Middle West States—Ohio, Indiana, Illinois and Iowa—where the work has been so all-embracing as to render difficult any reliable calculation as to the untouched farming acres. Progress in this group of States is unmistakable, and where accumulated moisture has not been displaced the agencies of organized effort are well on toward the execution of systematically defined plans. One county in one of these above-mentioned States supports 200 drainage districts, while still another efficiently organized drainage districts of the Middle West, tile of five inch diameter is favored The reason for the larger tile is obvious, inasmuch as any irregularity in the make-up of small sized drain for convey ing off the accumulated water is decreased in proportion. The variously shaped tiles of former days—distinctive among the types being the horseshoe tile with a flat bottom, either open or closed—have been superseded by those of a cylindrical shape, that is, with a round bore In recent years, concrete tile has come into extensive use, its adaptation having been very widespread in the Middle West However, the popularity of clay tile is not to be minimized.

The veteran ditcher—whose predilection for the use of the simple spade had its source in other lands than America—is fast disappearing, according to the drainage engineers of the Bureau of Public Roads. Attractive wages in the city, shortage of labor in more profitable occupations, and economic disturbances are probably the causes which have speeded the going of the immigrant who obtained his knowledge of the rudi ments of ditching "in the old country" His departure has been capitalized mechanical ingenuity has worked at top speed, and the development of a multitude of tile trenching machines, operated by steam or gasoline engines has been the fortunate result. Instead of the laborious hand method of installing a system for facilitating the flow of excess water, machinery digs the trench to the specified depth at a single operation The types of implements vary from the inexpensive ditching plow, costing from $20 to $500, to the costly equipment designed for contractors and large plantation owners, entailing an investment of $6000.

D L. Yarnell, senior drainage engineer of the Division of Drainage Investigations, summarizes the three requirements of a good trenching machine It should operate efficiently in all types of soils, should be capable of cutting true to grade, and should have the capacity for standing up under working periods of indefinite length without disarrangement or breakage Hard shale, cemented gravel, sand, stones, loose loam, soft muck, and sticky clay, comprise the varied assortment of soils, for having a versatile equipment, it can be adapted to varying conditions. For instance, open or skeleton excavating buckets are best suited to sticky soils, while solid buckets perform efficiently in loose, dry soils. Obviously strength is a prerequisite for a machine that would labor in shale or stony ground—lest the barrenness of its results should be like the scriptural sowers of seed, its efforts being non-productive

According to classes, trenching outfits are four in kind. plows, scoops, wheel excavators and endless chain excavators. The names of the first two betray their natures. They are operated by horses, and they frequently function simply to loosen the dirt in order to facilitate hand shoveling "Wheel excavators" is a term which has reference to the fact that the buckets are arranged around the outside of a wheel, while the buckets on the endless chain type are conveyed on parallel endless chains supported by a long steel frame at the rear of the machine. One end of the frame is lowered so that the buckets are drawn upward toward the machine and thereby cutting a thin slice of earth from the bottom to the top of the trench. Scraper excavators are identical with the drag-line machines designed for wide ditches, being some-

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The ditching plow is

could not be afforded.

of handwork is required to smooth the trench for laying the tile. The capacity of the ditching plow is frequently limited to the excavation of a trench of only 2½ to 3 feet in depth, a depth not adequate in numerous localities. It is primarily a farm tool, serving the purposes of the farmer who desires to drain a portion of his land. The implement is powerless in extremely wet and boggy soils where horses cannot travel. The outstanding virtue of this type of equipment in contrast with those of the elaborate excavator is its cheapness.

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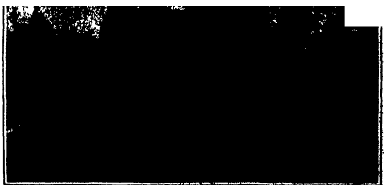
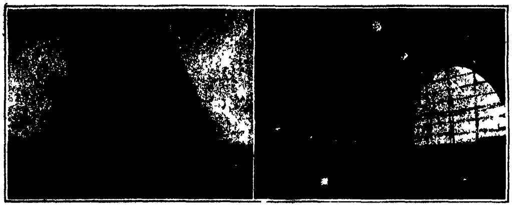
Marked innovations — although seemingly slow of evolution — have been inaugurated since the auspicious day in 1835 when John Johnston laid the first drain tile in the United States, the event taking place in Ontario County, New York Significant it is that 84 years later —in the spring of 1919—not far removed from the spot where the historical tile-laying was commemorated, farmers pooled their interests, organized a company, and cooperatively acquired a power-trenching machine The methods employed by Mr Johnston are mainly in vogue in this particular locality Elsewhere a larger diameter of tile has been installed, the two-inch measurement having been abandoned for four-inch material while in the



A horse-drawn ditcher for shallow tile ditches

Concrete in Surprising Places

By employing the principle of the arch, large surfaces may be roofed over in a very simple manner by the use of reinforced concrete, and this method is especially applicable where it is required to construct aero-sheds having a considerable size. For airship use, the question of the height of the structure is another factor which enters into the consideration. A good example of recent practice is shown in the large aero-shed which was built for the French Navy at Montebourg by the *Fourré-Rhodes* establishments, according to the plans of Engineer Lossier. The outside dimensions of the structure are, length 500 feet, width 188 feet, and height 100 feet.

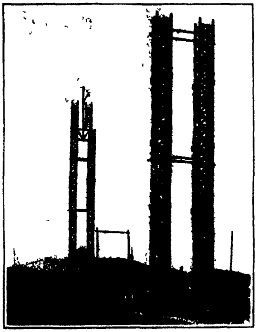


Outer and inner views of the end of an aero-shed of reinforced concrete, a recent French design

In principle, the portion which forms the vault is kept separate from the side or upright part of the structure, but to the eye, the whole has the appearance of a uniform construction, and as will be observed in our engraving, the principal members are spaced along the length of the shed and have a general parabolic shape. But for each of these principal members, the lower part consists in reality of a girder of triangular shape, having on the inside a straight or vertical beam and on the outside an inclined beam, these being considerably spaced apart at the bottom to form the base of the structure, while they are brought together at the top, the whole being suitably cross-braced. On the top of this substantial girder which may be likened to a half-tower, is mounted the reinforced concrete beam which is curved into the general shape of the vault, and it rests on the base portion through the medium of a special joint of the kind which is now commonly employed for this class of structural work and termed semi articulation, and in which the metal rods form practically the entire connection between the parts. The main girders of the structure being thus obtained they are cross-connected by the longitudinal portions which run along the whole length of the shed, then a special slab of reinforced concrete of light and strong make-up is laid over the spaces in order to cover the building.

The triangular upright members are spaced in pairs at 80 feet representing the inside width of the shed, and have a spread of 26 feet 3 inches at the base. Both the straight and the inclined beams contain six reinforcing bars of round iron. At the bottom of each is a good sized base of three feet three inches square the reinforcing bars passing down through the base and anchoring in a concrete foundation of five feet square. The uprights are molded and flowed with concrete on the spot, being spaced along at 10 feet 6 inches between centers, but the horizontal connecting beams are made up at the works, leaving the bars projecting out at the ends of these pieces so as to be able to make connection with the vertical members while these latter are being formed. The cross members have a general square shape, but are given a channel bar section for the sake of lightness, the fleet side being turned outwards, this portion having a small rib along the top and bottom. Spaced apart at six feet four inches on the height of the shed, these beams serve also to support the flat covering slabs. The top or arched portion of the shed consists of beams formed in parabolic shape and corresponding to the base members upon which they rest by the semi-articulations, another joint of the same character being provided at the top of the vault.

One of the original features of the new construction is the use of a large flat covering slab which was designed by M. Misard, and it is of unusual size, measuring some 7 feet by 5 feet 6 inches. These reinforced concrete slabs which are simply laid upon the structural beams after the manner of the customary roofing tile, are very well adapted wherever a large surface requires to be covered, and may thus find numerous applications. There need no longer be any apprehensions as to an excessive weight of material when it comes to applying reinforced concrete for the sides and especially for the roofing of structures, and especially in the case of large sheds for airplanes or airships. A very light weight is obtained for the present type of roofing slab. In spite of its large size it can be made as thin as 0.4 inch, and the metal reinforcing portion consists of wire gauze with very small mesh. As noticed in the sectional view, it is formed with a stiffening or ribbed portion along the sides and has two additional ribs of suitable shape at the middle part. The top and bottom parts are given a suitable shape for applying the slab upon two of the cross beams of the structure, this method being very simple and convenient. In order to facilitate the handling of the slab, which weighs about 330 pounds, the lower iron rod which is used for reinforcing the middle ribs is made to project somewhat at the top of the slab and has the shape of an eyelet, and this also aids in securing the slab to the cross beam. Tests for the strength of these reinforced concrete slabs are made by supporting them at the ends and loading them over the whole surface with sand, representing the weight which the slab is required to support.



Another surprising application of reinforced concrete—in high radio towers

These interesting sheds do not by any means exhaust the novel uses of reinforced concrete, which are in fact being added to almost every day. Just as a further example may be mentioned an other French development which involves the use of this type of structure for towers of extreme height. Radio towers especially are being built in this way, and are attractive in appearance as well as substantial. Tempests will not blow them down, as was proved by some of the high towers erected at St Pierre. What is a novel feature is that the tower can be made up, say of 15-foot lengths, which are formed on the ground and then hoisted into place. This means much quicker work than when a steel tower has to be built.

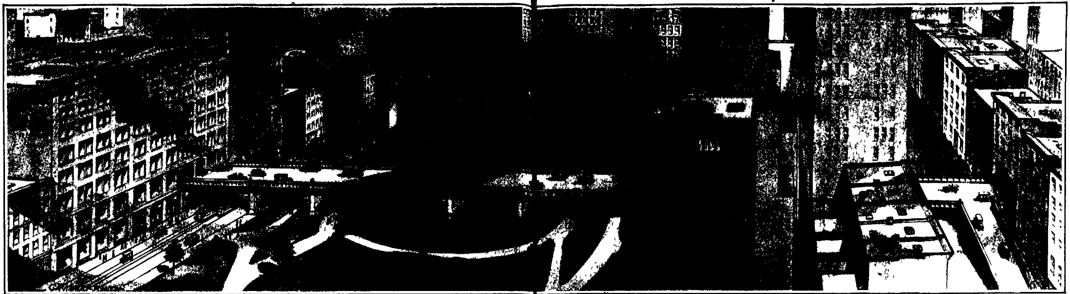
The concrete aero-shed from the side, during the process of construction

Poisoning by Illuminating Gas

THE only constituent of illuminating gas which has serious poisonous properties is carbon monoxide. Carbon monoxide has the property of forming a dissociable compound with the haemoglobin of the blood just as has oxygen but the affinity of carbon monoxide for haemoglobin is about 210 times that of oxygen for haemoglobin. The greater the extent to which the haemoglobin becomes combined with carbon monoxide the less is its capacity to act as a carrier of oxygen between the lungs and the tissues of the body, and if a sufficient amount of the haemoglobin in the blood becomes combined with carbon monoxide the normal oxygen supply to the tissues must evidently be seriously affected. The effects produced by severe carbon monoxide poisoning are in fact, those of slow or rapid asphyxiation.

The minimum concentration of carbon monoxide that will prove fatal is not known with certainty, but the available evidence points to the conclusion that death will ensue after an exposure for several hours to air containing 0.2 per cent of the gas. Much depends on the length of time that the blood has been highly saturated with carbon monoxide, for the longer an extensive shortage of oxygen is maintained the more serious is the damage to the tissues of the body, particularly to the nervous system and the more difficult is recovery. Bearing this in mind it is not improbable that 0.15 per cent of carbon monoxide in the air breathed might prove dangerous to life in the case of prolonged exposures, according to *Nature*.

Exposure to relatively high concentrations of the gas leads, of course to rapid loss of consciousness and death, but in accidental cases of poisoning the concentration of carbon monoxide is, as a rule, comparatively low and in these circumstances the onset of symptoms will be gradual though progressive for the gas, owing to its low concentration, will diffuse but slowly into the blood and it will be long before complete gaseous equilibrium can be established between the blood and the air in the lungs. Herein lies a great danger, for so insidious is the onset of the symptoms that the person affected may not realise that anything is amiss until he has lost so much of the power of his limbs as to render it impossible to withdraw from the danger. With 0.1 per cent of carbon monoxide in the air breathed a resting person will become disabled in about two hours and a half with 0.2 per cent in little more than an hour, and with 0.4 per cent in about half an hour.



Proposed automobile elevated roadway, to extend north and south through Manhattan Island. The structure would pass through the center of the blocks

Solving the Street Traffic Problem

Speeding Up Traffic by Separating the Through and the Local Traffic

IT is doubtful if many people outside of a few who have made a special study of the congestion of street traffic are conscious that because of the multiplication of automobiles and motor trucks some of the larger cities of this country are threatened with an absolute tie-up of traffic in certain congested centers which cannot be long delayed.

There are today between ten and eleven million registered automobiles in the United States and the curve of increase is rising at an accelerating rate. Already the main thoroughfares of the more densely settled sections of the country are showing signs of congestion and on holidays and Sundays the situation has become unbearable. It is in the larger cities, however, that the crowding of the streets has reached a point where it has become a daily and very serious problem with promise, if emergency measures are not at once undertaken, of producing on the main thoroughfares and particularly at certain intersections of the main streets an absolute deadlock during the busier hours of the day.

The most serious conditions are to be found in the largest cities, where we should naturally look for them and particularly in New York, where the traffic doubles every three years. Here, the congestion which naturally arises from a great congregation of inhabitants is intensified by the fact that Manhattan, which constitutes the business center of New York, is a long and comparatively narrow island, in which the principal flow of traffic is north and south along the length of the island, with the short east and west streets serving merely as feeders to the congested north and south thoroughfares.

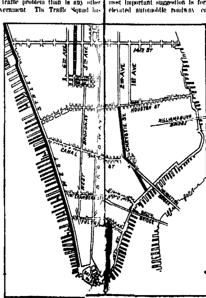
The north and south street travel is accommodated on eleven avenues, and if the automobiles and motor trucks were distributed evenly among these all would be well—but it is not. On the contrary, the traffic on the avenues near the Hudson and East Rivers, except on West and South Streets, is comparatively light. It grows denser as the center of the island is approached, and it is found at its worst on Fifth Avenue, where the conditions are unspeakably bad and rapidly growing worse.

Other things being equal, the amount of traffic we can pass through a given thoroughfare in a given time may be said to be proportional to the average speed of the vehicles. In New York there are several conditions which slow down this speed. Chief among these are: First, the fact that fast and slow moving vehicles are using the same thoroughfares; second, that many of the streets are occupied by surface cars which, when they stop as they do at practically every street corner, cause the automobile traffic behind them to stop until the alighting passengers have left the car and new passengers are taken on; third, the fact that on several thoroughfares the free flow of the traffic is hindered by the columns that carry the elevated railways; and lastly, there is the unfortunate fact (for the flow of traffic) that the city fathers laid out the blocks, so that their longer sides run east and west and their shorter sides north and south, with the result that the crossings come three times as frequently on the avenues as they do on the cross streets. Now, of these unfavorable conditions, the last-named can never be changed, but the other three—namely, the presence of fast and slow traffic on the same avenues, the presence of street-car lines on the avenues and the presence of the elevated structures, are non-essential and the solution of this stupendous problem will be obtained only when the city takes the drastic measure of removing some or all of these three primary obstacles.

Proposed elevated roadway down West Street for fast, through automobile traffic, from Riverside Drive to the Battery

In the City of New York the Police Department is in closer touch with the traffic problem than is any other branch of the city government. The Traffic Squad has been making heroic efforts for years past to cope with the increasing congestion, and from time to time it has formulated rules based upon past experience, which have made it possible to keep the full flood of traffic moving—in a fashion. Today, however, Richard E. Enright, Police Commissioner, has come out with the statement that frankly he has done all that he can in the way of traffic adjustment and that the situation calls for immediate and very drastic remedy. He assures us that a definite traffic plan, approved by the city and the public, must be got under way at once. This plan must utilize to the utmost our present facilities, and it must be one that can be put into operation without unnecessary delay.

The Commissioner believes that we should create a permanent board with authority to project new roadways for the handling of present and future traffic. Such a board is essential, since it is difficult for city officials, who are continually changing, to prepare and carry into effect a comprehensive plan like that which is described and illustrated in the present article. The most important suggestion is for the construction of an elevated automobile roadway, carried north and south through the center of the blocks between Fifth and Sixth Avenues. For the present, it would be sufficient to build this roadway from 50th Street to Washington Park. Ultimately, it would be extended as the situation might require. Where the cross streets are intersected the roadway would form an elevated structure having sixteen feet of headway, and designed on artistic lines so as to soften the usually harsh appearance of such structures in this city. The roadway would take up the space between the second and third floors of the buildings through which it ran. The shops opening on the cross streets, and the offices and establishments above the third floor would not be disturbed. Now this idea is not so radical as it might seem at the first blush, for the four walls of the structure would be of concrete and since only pneumatic tired traffic would be permitted there would be no noise, odor or vibration to disturb the occupants of the building.



Lower Manhattan, showing by heavy lines the West Street elevated roadway and the extension of Second Avenue to South Street

Another addition to the traffic capacity in a north and south direction would be secured by the removal of the elevated structure from Second Avenue, between the Harlem River and Chrystie Street, and the enlargement of Chrystie Street to the same width as Second Avenue. At the Plaza the route would swing under the bridge approach to continue at full width on Market Street to South Street, on the East River. Thence it would follow South Street down to the Battery.

Another important increase of travel facilities contemplated in this plan is the construction of an elevated roadway, wide enough for several lines of traffic, from the neighborhood of Riverside Drive down the westerly side of West Street, to the Battery. Both this structure and the one built through the center of the blocks between Fifth and Sixth Avenues would be provided at suitable intervals, with ramps leading down into the side streets by which local traffic or fast through traffic, for that matter, could enter or leave the elevated roadways at any point desired throughout the full length of the city.

Another important suggestion of the Commissioner is to give up the whole width of Fifth Avenue, from building line to building line, to street traffic, moving the sidewalks within the building line and thus forming a continuous arcade for the whole length of Fifth Avenue between 50th Street and Washington Square, or as far south as the present conditions and future probabilities of congestion render advisable. The removal of the sidewalks would provide accommodation for at least two more lines of traffic in each direction.

The Commissioner's plan will be criticized on the ground that these are very sweeping and costly measures. They are, and the situation is such that they have to be. Matters cannot go on as they are. The urgency is so great as to call for the immediate formation of a thoroughly expert commission, carefully chosen from men who are qualified for the study and solution of traffic problems. The commission should be independent of party politics and it should be a permanent body. We owe our fine water supply to the formation of such a board in Mayor McClellan's day, and this great public work is a lasting tribute to his wisdom and farsightedness. The traffic problem rivals the water supply problem in importance. If the present Mayor would listen to his Police Commissioner and create an expert, non-political Board on Traffic, he would confer a lasting benefit upon the city.

Widening of Fifth Avenue for automobile traffic by placing the sidewalks within arcades, thus providing for four additional lines of automobiles

Ruling of Scales by Means of Light Waves

THE Bureau of Standards has recently completed the ruling of 10 six-inch scales for a manufacturer of precision tools using the method recently developed which depends on the interference of light waves. The first inch of these scales is ruled in fortieths, and it is interesting to note that these scales are of such a degree of accuracy that when used for the work for which they were designed no corrections whatever need be introduced; in other words they are perfect instruments for their purpose. Two similar scales were ruled for the use of the Bureau and another of extreme accuracy, 1 mm in length with lines 10 microns apart, was ruled for the use of the length section.

Digging in Sacred Soil

Research With the Spade in Palestine Since the War

The well of Harod, where Gideon selected his braves

Part of the ancient wall of Jericho now uncovered

GREAT Britain has risen to the full measure of her responsibilities in Palestine, both as regards the protection of the historical monuments and sites and the organization and encouragement of research in the Holy Land. A British School of Archæology (analogous to the older-established institutions at Athens and at Rome) was founded in Jerusalem soon after the end of the war, to provide a home and center for research and advanced study. Sir Herbert Samuel, his Majesty's first High Commissioner for Palestine, created, as one of his first official acts, a Department of Antiquities for Palestine, charged with the protection of the historic monuments of the country, the arrangement of a national *museum, and the organisation* and control of excavations and research. The Government properly regards the administration of the antiquities of Palestine as a trust confided to it by the whole world, accordingly, an International Board, of which the Director of Antiquities is Chairman, advises the Department on all matters of public interest. This board includes representatives of the different communities, and of the societies of foreign countries engaged in archæological research in Palestine.

The first fruits of this new endeavor are now becoming visible. Professor John Garstang, D.Sc., of Liverpool University, gives through *The Illustrated London News*, an account of the progress of historical research, and the protection given to ancient remains in the Holy Land, under the established British regime. Pro*fessor Garstang is the organizing director* both of the British School of Archæology in Jerusalem and of the Department of Antiquities for Palestine; he writes with the authority of scientific experience and those who may have entertained doubts as to how far political and other considerations might affect Great Britain's fulfilment of her trust in regard to the antiquities of the Holy Land, will be reassured and gratified by the professor's definite accounts.

Special monuments, like the great Crusaders' Fortresses of Acre and Athlit, the Roman city of Cæsarea, and the Philistine site of Askalon, have been put under guardians, and museums are being organized where all the local remains may be preserved and studied. A central museum has been established in Jerusalem, with a distinguished Oxford graduate as keeper, and already the *framework* of a representative collection is open to the public.

It is in the field of excavation and research that the most noteworthy activity *may* be recorded. The new regulations may appear to be severe and meticulous, but in practice they are found to be a real safeguard against unscientific treasure-hunting, and while protecting the just rights of the national museum, they provide efficient help and encouragement to properly conducted expeditions working on behalf of societies whose academic and scientific status is unquestioned.

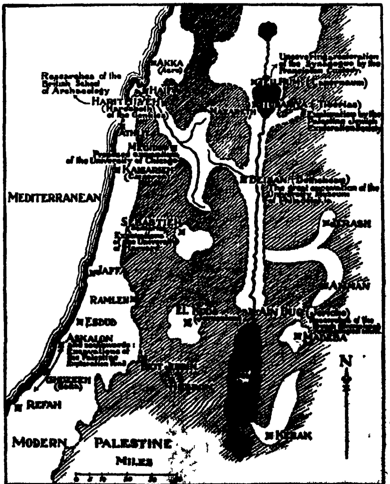
Our map shows the sites already being excavated, and those where work is projected for the next season. No fewer than eight properly equipped expeditions are at work and the results of this combined effort promise to be far-reaching. On the eastern side, in the Jordan Valley, at Ain Duq, near Jericho, the French Archæological School (Ecole Biblique) conducted by the Dominican Fathers has cleared and removed for protection portions of a mosaic pavement of an ancient synagogue of the third century. Hereabouts is the famous mound which marks the site *of ancient Jericho*. Considerable clearances were made here in the course of excavations made in other days, disclosing walls of undoubted antiquity, both those of houses and main walls of the city. But the historical interpretation of these researches is not complete. The excavation *was not made* with that due regard to minutiæ which modern science demands, and there lacked then, as now, sufficient comparative material, properly collated and arranged, by which to deduce the full and logical results from the work done. Doubtless some learned society will come forward in the future to undertake the task in a modern fashion.

Further north is Beisan, the "Key to Palestine," dominating the junction of the valley of Jezreel with that of Jordan. Here the University Museum of Philadelphia has commenced work on a well-conceived plan under the able direction of Dr Fisher, backed up by resources proportionate to the undertaking, and rewarded at once by historical discoveries. Further west, in the plain of Esdraelon, is Megiddo, overlooking that most historic battlefield the memory of which survives in the suggestive word Armageddon. Here the University of Chicago, at the instance of Professor Breasted, will work. At the entrance to Esdraelon, the narrow neck leading from the plain of Acre, are Harithiyeh and Tell 'Amr, commonly identified with "Harosheth of the Gentiles," which looms large in the Song of Deborah as the advanced post of the Syrian league and the House of Sisera. It is here that the British School proposes to commence investigations this year. Samaria, crowning a hill in the heart of the hill country, has already been partly excavated, and in true scientific fashion, by the University of Harvard, under the leadership of Dr Reisner; the same body has applied for a new concession.

The views shown on the facing page are as follows:

1: The ancient town of Tiberias, on the Sea of Galilee. 2: Where Christ "entered into the synagogue and taught" in Capernaum. 3: Armageddon, the symbol of world conflict. 4: Where Samson carried away the gates and pulled down the temple of Gaza. 5: The port of Caesarea, once the Roman capital of Palestine. 6: A field of biblical disaster, where the shield of Saul rusts "unanointed with oil." The mountains of Gilboa, the Vale of Jezreel, and the Jordan valley

SOME HISTORIC SCENES IN PALESTINE THAT ARE NOW BEING LAID BARE BY PICK AND SHOVEL OF THE ARCHAEOLOGISTS



Map and photos, courtesy Illustrated London News

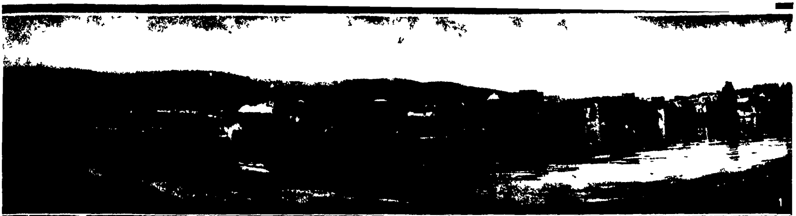
Sketch map of Palestine today, showing the points at which excavations are now being carried forward

The Palestine Exploration Fund has been engaged these two years on an extensive excavation at Askalon, the ancient Philistine city, and this year that pioneer body will expand the area of its work and investigations to other Philistine sites in the vicinity, even as far as Gaza and southward, in order to obtain a proper and fuller interpretation from the historian's point of view of the very important evidence already recovered.

We may conclude this catalog of the present sites of excavation by reference to two upon the shores of Lake Tiberias (the Sea of Galilee) the interest of which is more local and the work self-contained. Just south of the modern town of Tiberias the young Palestine Jewish Exploration Society has examined the ground bordering on the lake, recovering evidences of the period of the Talmud in traces of buildings, inscriptions, sarcophagi, and a profoundly interesting relic in stone reproducing crudely but in a well-defined manner the decoration of the seven-fold "candlestick," or Minora, as described in the Book of Deuteronomy.

To most visitors to Palestine the work which has been proceeding for some years near the head of the lake at Tell Hum, under the control and direction of the Latin "Custody of the Holy Land" (ancient title descended from the Crusades), is that which appeals as of special interest and charm, alike from its character and associations as from the picturesque beauty of the scene and surroundings. For this is the site which corresponds most nearly to that of Capernaum.

The recent announcement that excavations are to be made at Jerusalem in a search for David's tomb has aroused anxiety in local religious circles of Jerusalem where it was feared that the work would violate sacred sites. The British Colonial Department, however, has issued a reassuring statement that the city stood on a triangular space of ground called Mount Ophel and this site has hitherto been of no religious interest to Christians, Jews or Mohammedans.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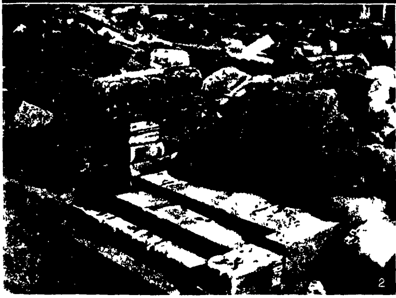
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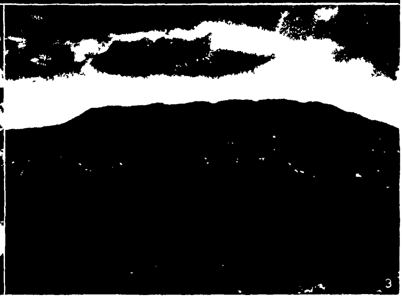
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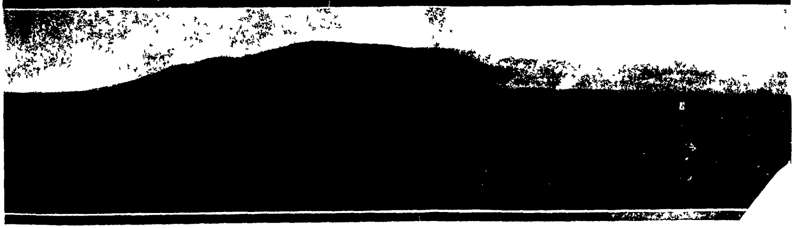


Sawing Stones With Man-Made Stones

How Abrasives are Employed in Cutting and Shaping Marble and Granite for Building Purposes

By J. F. Springer

EXCESSIVE hardness is so often associated with fragility that the use of the diamond in cutting marble and granite seems more or less unusual. Similarly, carborundum, alundum, aloxite, etc., appear scarcely suitable when applied to the cutting and fashioning of stone. Yet, one or more of the artificial abrasive materials have already gone into such service and are in daily commercial use. Big circular saws have inserted teeth of carborundum, saws that are used in the cutting of marble slabs and the like. Great planing machines are in use where big granite columns receive their flutes by the employment of similar means. Marble balusters are cut with accuracy and dispatch from rectangular blocks, carborundum being the active agent. Glass itself is very hard, but it yields to the modern abrasives. In fact, the cut glass industry is just about dependent upon abrasive wheels for the production of its designs.

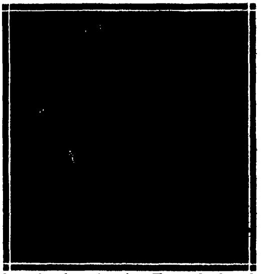
Most uses of abrasives call for high speeds. The particles of hard and angular materials are not rigidly held on the periphery of the saw. The cut is secured largely by the velocity with which the particles meet the work. It is almost, but not quite, as if the bits of abrasive were little projectiles. However, a projectile depends solely upon its own momentum, whereas the abrasive particle depends partly upon the backing of the matrix in which it is set, as well as upon the momentum possessed by it. Since the weight is quite insignificant, this momentum is due largely to the velocity. Consequently, in order that a small particle, held more or less loosely, shall really have a substantial momentum, a considerable linear speed is necessary.

The standard linear speeds run, say, from 5000 to 10,000 feet per minute. This means that the particles of abrasive meet the work at velocities roughly estimated at from one to two miles per minute.

A little reflection will perhaps suffice to show that such speeds require either a high number of rotations per minute (as with small wheels), or a large diameter of wheel, or a combination of considerable rotational speed and a moderate diameter.

Perhaps the use of carborundum inserted tooth saws constitutes the most notable of recent advances. There is, first of all, a disk of steel. This may have a diameter as small as 30 inches or as large as 84 inches, or more. The linear speed at the periphery is properly 7000 feet per minute. This can be produced at the very moderate rotational speed of 318 r.p.m. if the effective diameter is seven feet. Even with an effective diameter of 2½ feet, the r.p.m. required will only be 891. However the work in contemplation consists of the softer stones, such as marble, limestone, sandstone. I do not know that granite is commercially cut by inserted tooth saws. Whenever this becomes practicable, the linear peripheral speed will doubtless have to be increased, say, to 10,000 feet per minute. In fact, the necessity for such high speeds may be the real reason that saws for the cutting of granite seem yet in the future.

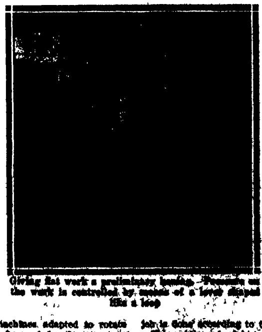
The business part of the inserted teeth is of a very plain shape, its form being rectangular. These rectangular portions project beyond the periphery, while the basal portion lies within the circular outline of the steel disk, that is, it is set in a notch made for it in the steel. The base tapers outward on both sides. The notches also widen as one passes from the rim toward the center. Notch and tooth are so related that the tooth may be set in position in the notch and then rigidly held by a wedge which tends to force the tooth radially outward. The teeth, and especially the projecting portions are flat. They come in two or three sizes. A steel disk so dimensioned that with the teeth inserted it will have a diameter of 80 inches, will have 16 large teeth or 25 small ones. A saw 46 inches in diameter when the teeth are set will accommodate 25 large teeth or 40 small ones. A large saw such as this, when running with a linear peripheral speed of 7000 feet per minute, will be rotating at about 557 r.p.m. With 25 large teeth round its circumference, 13,925 teeth will pass a given point per minute. With the 40 small teeth, we should have, under the same conditions, 22,280 teeth passing per minute. In this latter case, 371 teeth will fly by during each second.



Inserted tooth saw in action. The peripheral speed is 5000-10,000 feet per minute

If we know the speed with which the work advances, we may readily calculate the number of teeth which operate on the stone per linear inch of advance. Such saws as I have been describing are adapted to cut work from 4 to 36 inches thick. Suppose the work is eight inches thick and that the saw eats ahead at the rate of 12 inches per minute. This would be one inch in five seconds. With 371 teeth passing per second, the one inch cut would be made by the action of 1855 teeth. That is, 1855 separate cuts would be made in making an advance one inch long and eight inches high. Each square inch of this advance would be accomplished by 232 cuts. This means that the work accomplished by the passage of one tooth amounts to the removal of a cross-sectional bit of stone about one-fifteenth inch high and about one-fifteenth inch long.

It has already been said that the several teeth are held in position by wedges. The top and bottom edges of a tooth are not parallel. The forward end of the tooth is, in fact, not so deep (from top to bottom) as the rear end, the words "forward" and "rear" having reference to the direction of movement of the saw. The bottom of the slot is just about parallel with the top. Accordingly, the wedge is driven from front to rear. It is said that this method of securing the teeth is adequate to all conditions. No plastering is said to be required even when cutting fine moldings, fluted columns, etc. The teeth may be removed and re-inserted at will. The saws require but little mechanism for their successful operation. Machines built for using an abrasive wheel consisting of a steel central disk and an outer rim of an abrasive set in a suitable matrix are suitable for saws having inserted teeth of carborundum. Similarly, machines adapted to rotate diamond circular saws may be used for the new type of saw. Naturally, if the saw is simply rotated and is to be given no other motion, the bed upon which the work is secured must be given a movement toward the saw. Probably the inserted tooth saw can also be mounted in a swinging frame or in a frame designed to be reciprocated horizontally.



Giving flat work a preliminary honing. Pressure on the work is controlled by means of a lever shaped like a loop

Balusters of marble and limestone are now being made in considerable quantities by means of carborundum wheels. In this process there are two methods of procedure. In the one, a machine analogous to the ordinary turning lathe is employed. The rectangular block of stone is properly set between centers on this lathe and then rotated at about 100 r.p.m. A big molding wheel of carborundum corresponds, in this case, to the cutting tool of the ordinary lathe. This has a surface the exact reverse of that of the baluster. That is, if, when the job is done and while molding wheel and finished baluster are yet in contact, a plane be passed through both axes, the region of contact will be one and the same line. Where the baluster bulges out, the molding wheel is cut in, and where the baluster is cut in, the molding wheel bulges out. This molding wheel may consist of a single piece, or it may be made up of a gang of separate wheels. It is operated at a high speed. Naturally, however, the linear peripheral speeds will vary with the varying diameters. One may say that the molding wheel should be operated at such a rate as to give a linear peripheral speed of 5000 feet per minute, but this would be a loose and vague way of speaking. It would be perfectly definite, however, to say that the part where the diameter is at a minimum should have this linear peripheral velocity, or that the place of average diameter should have it.

At any rate, the molding wheel is rotated at a sufficiently high rate and while thus in rapid action is slowly moved against the slowly rotating block. The machine is so designed as to provide a means of feeding the molding wheel into the block and thus forming the desired baluster. This machine differs from the ordinary turning lathe in that the cutting tool is rotated, and rotated at high speed. In this respect the device rather resembles the milling machine.

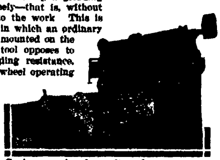
The cutting may be facilitated by dividing it into two parts. In the earlier part of the cutting, a slotting wheel is used in place of the molding wheel. This slotting device consists of a gang of coping wheels, so dimensioned as to cut circular slots in the rectangular block of stone, these slots having depths suited to the general form of the baluster desired. The molding wheel is next used. The work may now proceed more rapidly because of the preliminary slotting.

The balusters must naturally have ends perpendicular to the axis, and often the bases will have square sections. Sometimes, the block is jointed and squared before it is put into the lathe and given its complicated form. But these operations may also be done with the abrasive wheel subsequently to the molding operation. That is, an abrasive wheel two or three inches thick is mounted on the spindle which accommodates the molding wheel. It is then run at a high rate of speed and made to cut into the molded but not quite finished baluster, while the latter slowly rotates. The baluster may in this way be cut to the proper length. The squaring operation is performed on the planer. The block, now nearly a finished baluster, is put on the planer and the latter made to carry it forward beneath a rotating abrasive wheel about three inches thick. It is only necessary that this wheel shall pass over the surface a reasonable number of times, and the job is done according to the design.

The molding wheel just described is simply a [illegible] wheel that may be used for simpler work in a simpler form. For example, wheels are given a [illegible] form suiting them to cut the regulation [illegible] used for decorative purposes. In this case the wheel may be only an inch or a few inches thick. The work is well [illegible] as a planer. The [illegible] wheel is set up at the [illegible] of the machine and the

work is spat beneath it on the platen. Where a good deal of stone has to be removed, it is possible to use a coarse grit wheel for a preliminary operation. This class of wheel is competent to do deep and fast cutting. In fact it does the roughing work and is followed by a molding wheel made from a finer grit. The wheels may be made at the factory to correspond with any design wanted, and so do not cover merely a few shapes.

A notable advance made in recent years concerns the cutting of granite and other very hard rock. In fact, carborundum has been applied to the polishing, slotting, checking and fluting of granite. The polishing by means of loose carborundum has been going on for some time. An iron or steel scroll wheel is used to provide a resistant surface. But more recently this abrasive has been found suitable in the checking or rabbeting of granite blocks, and in the fluting and jointing of granite columns. Special wheels have been developed for the express purpose of dealing with this refractory stone. One advantage of using a grinding wheel is that the wheel cuts freely—that is, without opposing appreciable resistance to the work. This is radically different from the way in which an ordinary lathe tool cuts metal from a bar mounted on the lathe. In this latter case, the tool opposes to the work a stiff, almost unyielding resistance. The advantage of a free-cutting wheel operating on granite consists principally in the fact that such action pretty well eliminates breaking or damaging the stone. In connection with fluting, the abrasive wheel is run along the sides of the location where the flute is to be and so cuts two long slots. The material in between slots is then pinched out, and the stone cutter does the remainder of the forming by hand. This work of slotting for flutes is done on the planer, the wheel being set up at the head and the work being run under it on the platen of the machine. Jointing of granite columns is done with thin, solid wheels made of the abrasive. True joints are readily made and sharp arrises formed.

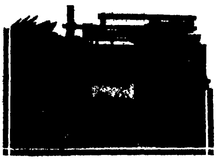


Coping a pair of granite columns preparatory to fluting. The machine does not require constant attendance

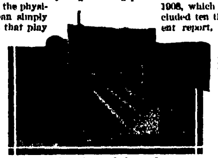
Cutting granite with a free wheel, thus having no advantage of pressure, is not the easy process that the cutting of marble is. To make a proper attack upon the hard, recalcitrant stone, a linear speed of 10,000 feet per minute is advised. The particles of granite are shot off, as it were, by minute projectiles impinging with a velocity of nearly two miles per minute. The wheels used are not necessarily large fellows. Consequently, with comparatively small wheels, it is necessary to use very high rotational speeds in order to develop the linear peripheral speed of 10,000 feet per minute.

In all the stone cutting operations, the wheels should be assisted by a jet of water. This jet impinges preferably at the point of action or very close to it, and at a pressure as high as 60 pounds per square inch. This is the pressure due to a head of 138 feet.

The accompanying illustrations show the various kinds of machinery employed in cutting and shaping stone, and also the inserted tooth stone saw with the abrasive teeth placed in dove-tail slots.



Slotting a baluster



Forming a balustrade

Quadrant of inserted tooth stone-saw, showing how the abrasive teeth are keyed in with wedges

The Physical Basis of Life

LONG ago it became perfectly plain that what we call protoplasm is not chemically a single homogeneous substance. It is a mixture of many substances, a mixture in high degree complex, the seat of varied and incessant chemical transformations, yet one which somehow holds fast to its own specific type for countless generations. The evidence from every source demonstrates that the cell is a complex organism, a microcosm, a living system. With the microscope we distinguish in this system a clear ground substance or hyaloplasm in which are suspended a great variety of formed bodies, widely diverse in form and function, each of which plays its own particular part in the activities of the system. Examples of these are the nucleus, the cytoplasmic chondriosomes, and plastids, also the Golgi-bodies and central bodies, and many kinds of granules and fibrillae. Some of them seem to be permanent, others transitory, formations that come and go in the kaleidoscopic operations of cell-life. Which of them are alive? Which, if any, constitute the physical basis of life? What, in other words, is protoplasm?

These are embarrassing questions. The truth is that the more critically we study them the more evident does it become that we cannot single out any one particular component of the cell as the living stuff, par excellence. Of this fact most experienced cytologists, including such eminent leaders as Flemming, Strasburger, Bütschli, Kolliker and Heidenhain, long since became convinced. "No man," says Flemming, "can definitely say what protoplasm is. In my view that which lives is the entire body of the cell." It is this view of the physical basis of life that has impressed us more and more as our knowledge of the cell has advanced, and this is as true of the physiologist and the chemist as of the cytologist. "We cannot," says Professor Hopkins, a distinguished biochemist, "without gross misuse of terms, speak of the cell life as being associated with any particular type of molecule. Its life is the expression of a particular dynamic equilibrium which obtains in a polyphasic system. Certain of the phases may be separated, but life is a property of the cell as a whole, because it depends upon the equilibrium displayed by the totality of co-existing phases." This conclusion is in substance precisely the same as that of the cytologist.

When we speak of protoplasm as the physical basis of life, therefore, we mean simply the sum total of all the substances that play any active part in the cell life, and we cannot exclude from the list such substances as water and inorganic salts which we commonly think of as "lifeless." At first sight this may seem a rather barren conclusion, but the fact is quite otherwise. No conception of modern biology offers greater promise of future progress than that the cell regarded as a whole is a colloidal system, and that what we call life is, in the words of Czapek, a complex of innumerable chemical reactions in the substance of this system. Modern investigation has indeed already profited so much by the point of view thus offered as to suggest that the study of protoplasm and the cell may be destined to pass more and more into the hands of the physiologist, the physicist and the chemist. In any case, the rising tide of cell research in these directions is of good augury for the future experimental analysis of vital phenomena. There are, however, other aspects of the problem which still escape the precise quantitative methods of the physicist and chemist, or are only beginning to come within their range, but which are none the less essential to our view of the general problem. I refer to those phenomena with which the cytologist, the embryologist and the geneticist must try to deal.—*Abstract from first Sedgwick Memorial Lecture by Professor E. B. Wilson, delivered in Boston December 29, 1922*

Pure Ozone

PROFESSOR E. H. RIESENFELD, of Berlin, has recently described, in the *Chemiker Zeitung* for October 7, the preparation and properties of pure ozone. Ozonised oxygen containing 10-15 per cent of ozone was liquefied in exhausted glass bulbs by cooling in liquid air. The deep blue liquid, on exposure to reduced pressure, gave off mainly oxygen, and at a certain composition separated into two layers, the upper, dark blue, layer was a solution of ozone in liquid oxygen, the lower, deep violet-black, layer was a solution of oxygen in liquid ozone. The lower layer, formerly considered to be pure ozone, contains about 30 per cent of oxygen at —183 degrees Centigrade. The oxygen was pumped off from it, and pure liquid ozone (B P —112.4 degrees Centigrade) obtained. The vapor density of 48 (O_3) was found by the Dumas method. On cooling in liquid hydrogen solid ozone, in violet-black crystals (M. P —249 7 degrees Centigrade), was formed. The gas, deep blue in color, is, in the absence of all catalysts, remarkably stable. Pure gaseous ozone can be exploded by an electric spark, but some remains unchanged. This would be expected from the endothermic character of the substance. The critical temperature is 5 degrees Centigrade. No evidence whatever of the existence of higher polymers of oxygen was obtained, both in the liquid and gaseous states the formula is O_3. This work is of great interest, and, apart from the determination of the physical properties of ozone, it removes the last doubt as to the simple character of ozone—"oxozon" does not exist.

Water-Power Plants in the United States

THE United States Geological Survey, in a recently published compilation of data regarding the developed water power in this country, shows that at present there are 3116 water power plants of 100 horsepower or more, with a total capacity of installed water wheels of 7,852,948 horsepower. Of this total 79 per cent is in public utility plants and 21 per cent in manufacturing plants. It is of interest to note that the census of 1908, which embraced plants of all sizes, included ten times as many plants as the present report, which embraces only plants of 100 horsepower or more.

New York still maintains its position as the leading State in the amount of developed water-power, with 1,291,857 horsepower, California is a close second, with 1,149,000 horsepower, Washington is third, with 454,856 horsepower, Maine closely follows in fourth place, with 449,614 horsepower, and Montana is fifth, with 344,420 horsepower.

To permit a comparison of the developed water-power with the total water-power resources a table is included showing the maximum and minimum potential water power of the United States.

The potential water power of the United States was determined by dividing the rivers into sections of different lengths, the length depending on the slope of the channel, and the fall and flow of each section were determined from the best information available. With these factors the potential water power of each stream was determined on the assumption of an efficiency of 75 per cent in the water wheels.

The minimum potential water-power is based on the average flow of the two seven-day periods of lowest flow in each year of record. This, of course, does not give the absolute minimum flow, but for all practical purposes potential water power based on the flow may be considered as continuous power. The maximum potential water-power is based on the flow available for 50 per cent of the time.

It is the general practice in the construction of water-power plants to install hydraulic machinery capable of utilizing stream flow far in excess of the absolute minimum and much in excess of the flow used in determining the minimum potential water-power as given in the table. This practice is forcibly brought out by comparing the minimum potential water-power with the total capacity of water wheels installed in water-power plants in some of the New England States. If all the water-power of the United States were to be similarly developed, it would probably be necessary to install plants having three or four times the capacity of the estimated minimum potential water-power as given in of the table.—*Abstract from article in Science for January 12, 1923*

The Airplane-Carrier "Langley"

WHEN the United States ship "Langley" joined the battle fleet of the United States Navy, she represented an old ship with a new name and an altogether new field of activity It would take a naval man to recognize, in the "Langley" of 1923, the collier "Jupiter" of 1912 Of the original ship, only the hull and the motive power remain Otherwise, she is a new vessel; and, so far as her duties are concerned, it would be difficult to imagine a greater change than from the carrying of thousands of tons of grimy coal to the transportation of some thirty or more trim and dainty airplanes.

In changing the ship over from collier to carrier, a clean sweep was made of all the structures above the upper deck, to make way for a broad, lofty and unobstructed flying deck Gone are the tall masts and the long line of derricks for handling the coal Gone also are the smoke stacks, and if someone who had never heard of airplane carriers, were suddenly to come upon the ship, she would look as though some giant carpenter had run his plane over her superstructure and then built upon the ship a vast table as broad and long as the vessel itself

The main deck of the Langley, showing on each side the latticed steel columns which carry the flying deck above

The "Langley" will always carry, in the the annals of the navy, the distinction of being the first large, seagoing airplane-carrier in the United States Navy, and in view of the supreme importance which aviation is bound to assume in future naval strategy and tactics, this will be no mean distinction. There is another claim to historical value which is of scarcely less importance We refer to the fact that when, as the "Jupiter," she was put into commission, this ship carried a new type of motive power, the electric drive, which was destined to be so successful as to cause it to be adopted as the drive for all capital ships of our navy A sister-ship the "Neptune," built at the same time, was equipped with a mechanical gear drive, and the "Jupiter" showed such superior performance that, so far as the turbines and gears built into the "Neptune" were concerned, there was no question of the superior economy and all-around performance showed by the "Jupiter"

The "Langley" is 542 feet long over all, with a beam of 65 feet and a mean draft of about 28 feet Her turbines and electric motors operate two screws and her speed on trial was 15 knots. Her original normal displacement was about 20,000 tons. She was launched in 1912, and converted to an airplane-carrier 1920-1921 In changing the ship over to a carrier, the structures above the main deck were removed and above this deck, along each side of the ship, was erected a series of lofty lattice steel columns, with a series of transverse girders running across the width of the ship to carry the flying deck. The whole series of columns was strongly braced, both transversely and longitudinally, and upon them was built a flying deck 534 feet long with nothing projecting above its surface except two signaling radio masts which can be housed vertically below decks. To conduct the furnace gases away from the ship, two horizontal smoke ducts are provided, which are inter-connected so that the smoke can be discharged on the lee side of the vessel.

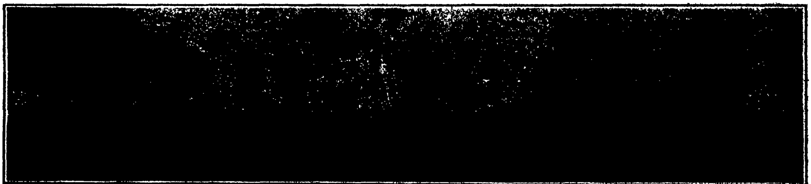
The large cargo space of the ship is available for storage of airplanes, spare parts, and the various equipment required by an airplane-carrier. There are magazines for the ammunition of the guns carried by the ship and for the bombs to be dropped by the airplanes. The gasoline tanks have a capacity of nearly 600 tons, and there are also tanks for the large amount of lubricating oil which must be carried. The tanks are served by an elaborate pumping plant, which leads to the hangars and to the flying deck.

The cargo holds have been altered so as to give the maximum amount of space for the stowage of airplanes, and the "Langley" is credited with carrying a dozen single-seater pursuit planes, a dozen two-seater spotting planes, four torpedo-dropping planes and six torpedo-seaplanes.

The illustration at the top of this page is taken on the main assembly deck below the flying deck. On each side will be noticed the lattice columns which carry the flying deck above Attached to the girders which support the flying deck are runways, while other traveling cranes for handling the planes from the hold of the ship and landing them fore and aft to the desired position. Here, after overhauling and inspection, unless that already has been done in the hold below, the runways pick up the planes and carry them to electric lifts, which raise them to the flying deck above. It will be noticed in our view of the main deck, that the planes are assembled transversely to the ship with the tail pointing outward.

One of our photographs shows a plane taking off from the flying deck during the recent maneuvers of the fleet at the Pacific entrance of the Panama Canal. Davits are rigged which serve to engage the airplane and bring it to rest in the shortest practicable time. It will be noticed that along each edge of the deck netting is rigged to which the operating crew can retire when the planes are flying off or flying on.

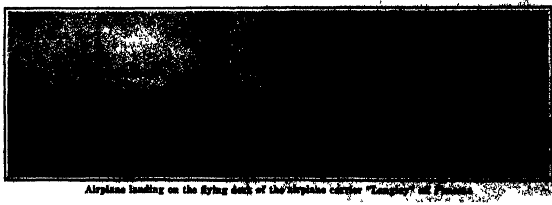
Very interesting is the central picture, showing the fall of a salvo of 14-inch shells during the bombardment of the old "Iowa"—a ship which took part in the battle of Santiago during the Spanish War. Of course, there was no one aboard the target; and she was steered from a distant ship by radio impulses, acting on electric magnets which controlled the steering gear. It should be understood that this radio apparatus had no part in the original equipment of the "Iowa," but was installed merely for target practice purposes. The "Iowa," steaming at about 10 knots, and constantly changing course, was attacked at various ranges corresponding to those which would be obtained in a modern engagement. The ship was under perfect control.



The splash of a salvo of 14-inch shells fired by the "Mississippi" against the "Iowa" (left). Ship in the foreground is observing the fall of the shells

Firing on the "Iowa" took place on two days. On the first day the "Mississippi" fired her five-inch, 51-caliber guns using thin-walled, high explosive projectiles. This firing took place at from 12,000 yards down to 8000 yards. Later that same day the "Mississippi" fired at the "Iowa" with her 14-inch, 50-caliber guns, using thin-walled, high explosive shells at an initial range of 19,000 yards, which was decreased during the run to approximately 16,000 yards. That night the "Mississippi" conducted a search operation using star-shells to locate the "Iowa," but not firing upon her. On the second day, the "Mississippi" again fired upon the "Iowa" at from 19,000 to 16,000 yards with her 14-inch guns and the thin-walled shells. Later that day, she made a second run, and administered the final blow, sinking the "Iowa." On this run firing was again opened at between 18,000 and 19,000 yards and nine-gun salvos were fired, using service projectiles in her 14-inch guns. After the ninth salvo, the "Mississippi" ceased firing and the "Iowa" [illegible]

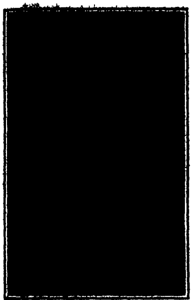
It should be explained [illegible]



Airplane landing on the flying deck of the airplane carrier "Langley" at Panama

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

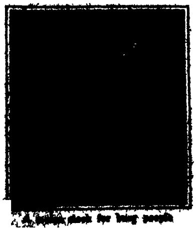


A voltmeter and ammeter for locating automobile troubles

A Combination Voltmeter and Ammeter

BY means of this combination voltmeter and ammeter any trouble in the electrical system of an automobile may be easily located. The instrument is a combination of five instruments—three voltmeters and two ammeters and it affords a means of measuring the voltage and current of any range usually found in automobile equipment. It is provided with ammeter leads with clips for instantaneous connection and voltmeter leads having prods. For special battery tests a cadmium electrode is included. The scale has a zero center and reads in both directions so that the meter may be read whichever way the leads are connected. The needle swings toward the terminal to which the positive side of the electrical circuit is connected.

The small button in the face of the instrument is used for setting the needle exactly on zero. In making the voltmeter tests a small button at the right is turned till the line points to *V*. In this position ammeter readings cannot be taken. Four terminals are placed at the bottom of the instrument. In making ammeter tests the small button at the right is turned till the line points to *A*. This connects the moving coil to the cables at the top of the instrument and disconnects it from the voltmeter prods at the other end. As many as 30 distinct tests may be made with this instrument.

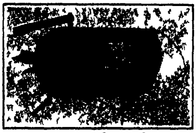


A [illegible] clock for busy people

Radiant Heat and Steam for the Complexion

A MASK which contains an electric light for the administration of radiant heat to the face and has in connection with a steam generator for additional treatment with steam is the product of a New York manufacturer whose claim is that this combination treatment is highly beneficial to the skin. The mask is made of aluminum. It envelopes the face, which receives the radiant heat from a 60-watt lamp reflected from the polished metal interior of the mask. At the same time steam is supplied from a generator which is heated electrically from any lamp socket.

Most skin diseases it is claimed, can be traced directly to the clogging of the pores which prevents the blood impurities from being expelled in the natural outlet by perspiration. The virulent matter then suppurates resulting in an eruption of pimples. The old method of using a saturated towel on the face is both unsanitary and ineffective as by this means perspiration is not induced, the skin being only wetted. Moist heat such as is furnished by the mask stimulates the nerves and causes a dilation inducing a deep flush. This brings about a sedative action which relieves tired nerves. Electric light from a white bulb destroys bacteria and acts as a tonic while blue light constricts the blood vessels, producing an anaesthesia which gives a sense of comfort and ease.



Steam-heating the complexion

A Clock That Never Forgets

MANY people have trouble in remembering appointments arising during their waking hours, and for this purpose the alarm clock idea has been extended to make possible and convenient a series of alarms or memory ticklers given as previously planned through out the day. Such a clock which is shown in the illustration goes further than this for the man who after being reminded that there was something to be reminded of cannot think what it is, there is provision on the clock face for inserting a number of cards opposite the hours when the alarm is to ring, each bearing a note about what is to be remembered. Thus the owner of the device after being apprised by the bell that he has something to do now looks at the card and discovers jotted down, "Telephone Mr. White. At 2 45 it alarms him into action and he learns on consulting the card that he has omitted to go out to lunch. Chronic automobilers will no longer discover that they forgot to purchase butter for tomorrow's breakfast for the clock will have jarred their consciousness before it is too late. This clock truly divides life into exact periods, and it will therefore meet with the wholesome approval of the very orderly, systematic person who believes in a time for everything and everything in its time. No fussing with dial indicators is required in setting this clock. The card is simply inserted in the slit at the particular 15 minute interval the alarm is wanted. Its end catches a lever inside the mechanism and sets off the alarm.

A Motor-Generator Charging Set for Radio and Automobile Batteries

A GOOD many people own radios, a large number own motor cars and quite a few own both. Here is a charging set for the starting batteries of the car or for the A batteries of the radio both of which have the good fortune to require the same voltage. The motor

Charge your own batteries from electric light circuit

part of this set which is the product of a Cleveland electrical manufacturer takes the regular 110-volt pressure at 60 cycles per second which means that it will suit the majority of electric light circuits in the U S A. The little D C generator gives current at 6 to 10 volts, and is equipped with clips ready to attach to your cells for charging. The set is provided with ball bearings at either end which practically eliminates lubrication troubles.

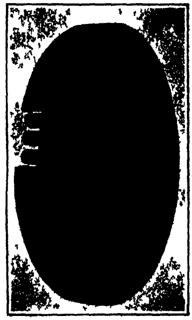
Steel versus Rubber

A FORTUNE awaits the maker of a vehicle wheel which has such high merit that it will supplant the rubber tired type now so almost universally in use. It is true that wheels enough to make a huge automobile of the Patent Office at Washington have been invented and patented yet despite all the effort thus represented the rubber tire, either pneumatic or solid rolls majestically on. Many of these wheels employ spring elements for spokes but it has remained for Mr W B Kerrick of Los Angeles, Calif. to use springs in the rim not a rare feature either but in this case they are used in a truly unique manner. They take the load not in a direction normal to the road surface but parallel to it. The wheel consists of a steel disk into whose periphery are let a large number of spiral springs having their axes as before mentioned parallel to the road surface. These springs are also let into the inside of a rim having a channel cross-section. As the rim does not touch the disk the load is continuously floated on the many transverse springs. It is claimed that the use of steel does away with much vibration as well as saving fuel repair bills oil and time and that steel is not so sluggish as rubber and will last longer.

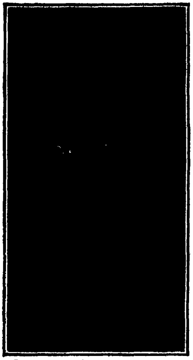
This instrument does many things

Electrical Etching, Demagnetizing and Annealing

AN electrical instrument which combines these three functions is the development of a Toledo Ohio manufacturer. In the process of the demagnetizing of tools which are used in connection with magnetic chucks, where it is necessary that the tools be kept demagnetized in order to be thoroughly efficient it is only necessary to pass them longitudinally across the surface plate while an alternating current flows in the coils. The instrument receives its operating current from an ordinary light socket. When it is desired to use it as an etcher in the marking of shop tools for instance it is only necessary to attach the pencil cord to the connection on the instrument and write with the ordinary touch on the tool. In addition to this the instrument may be used for light annealing and soldering. In the latter case a carbon annealing point is used in place of the etching pencil and the work to be annealed is held down to the surface plate magnetically. In soldering the instrument is used in the same manner as for annealing. After the carbon point has been applied the solder is flowed on in the usual way. The total weight is 20



Still another spring wheel



Directing traffic with the winking glove

pounds, so that it may easily be carried about a shop to any place where it is needed.

Stabilizing Carburetor Air

COMPLETE combustion of the fuel of an internal combustion engine depends upon the use of a correct amount of oxygen as proportioned to carbon and hydrogen. The fuel for such engines is usually a combination of gasoline and air. Gasoline is a fairly stable element of the mixture, but air, furnishing the necessary oxygen, is in constant variation and unless controlled to a practically uniform content and delivery of oxygen it disturbs these otherwise proportioned fuel elements, resulting in incomplete combustion with loss of power and waste of gas. Air contains oxygen in direct relation to its density. At high temperatures it rarefies and carries less oxygen to the cubic foot, but if its density is decreased by artificial saturation, its temperature lowers accordingly and its fuel value is restored and uniformly maintained. Such artificial air saturation is accomplished, according to the claims of its Niagara Falls makers, by a device for that purpose, called an air stabilizer. As shown in the illustration, this appliance takes the air through six humidifying or saturating screens which are kept moistened by a flow of water which is constantly drawn up from a basin by capillary action. This saturation increases the density of the atmosphere, reduces its temperature, and restores its percentage of oxygen, delivering to the carburetor a supply of properly conditioned air fuel. Large savings in fuel consumption are claimed.

A new attack on the miles-per-gallon problem

The Flashing Gloved Hand

A GLOVE having attached to its back a pair of small electric bulbs, one red, one white, connected to a dry cell carried in a pouch on the gauntlet of the glove is the clever invention of an Englishman, for the use of traffic policemen. Contacts are made by closing the finger next the color of bulb wanted. The signal is eminently practical because it becomes virtually a part of the policeman and is so quickly and easily manipulated that it finds constant use. There is very little about it to get out of order, or, like many devices employing electric lights in connection with the human form, to get in the way or be too heavy for comfort.

A Return to the Steam Motor Car

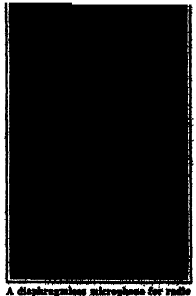
THE inventor of a new type of steam boiler for the automobile sees the use of gasoline for the self-propelled vehicle as only a temporary phase in the course of its development, while the steam propelled car, because of its comparative simplicity and insensitiveness to outside disturbances, is destined ultimately to "come back." One of the chief troubles that beset the steam automobile boiler, especially in the hands of operators who are not already steam engineers, was caused by an accumulation of mud from the injected water. This often quite fairly insulates the water from the fire, permitting the part of the boiler which is not covered with water to reach a higher temperature than the ordinarily limiting temperature of the boiling point of water under pressure and leading to its burning out at such points. Mr. Walter B. Kerrick of Los Angeles, the inventor of a boiler made to forestall such results, states that the vertical tubes of the new boiler are all welded into a ring shaped header at the bottom. Owing to the fact that this is below the level of the fire, when it gathers an accumulation of sediment it cannot burn out. The same principle is equally as applicable to the locomotive boiler. It is stated that this new boiler has been given hard service during two years and has stood up in a remarkable manner, owing to its careful design.

This steam motor-car boiler cannot burn out

Improving Radio Broadcasting

AS yet no method has been found for perfectly reproducing over a telephone transmitter or microphone all of the overtone components of the human voice and of certain orchestral instruments, like the violin, whose notes are so rich in overtones. Numerous attempts have been made and the record of these represents a steady evolution toward the desired goal of perfection. The chief trouble with the metal diaphragm has been that it has too much inertia and too little flexibility to follow the rapid vibrations made by certain of the higher notes.

The new transmitter illustrated on this page is the product of research by Dr. Phillips Thomas of the Westinghouse Electric and Manufacturing Company. Its distinguishing characteristic is its use of a direct current glow discharge at low pressure, which provides a means of ionization conduction in open air. The application of a moderately high direct potential between two electrodes separated a short distance in air, with enough series resistance to prevent formation of arc causes the establishment of a peculiar, low-current, high-voltage discharge having a glowing appearance. Such a discharge is remarkably quiet to the unaided ear. It is found that the incidence of sound waves at the gap will produce alternating potentials of equivalent frequencies. The sensitivity is surprisingly large, an amplification of ten to one will give loud signals in a head-set. Draft shields are used to exclude disturbing air currents.



A diaphragmless microphone for radio broadcasting

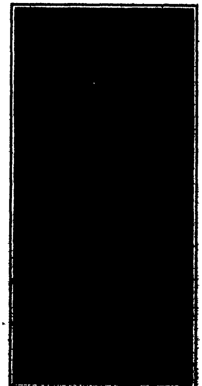
Locating Defective Wires

A VERY simple, though ingenious, method of locating either grounded circuits or broken wires in underground or concealed conduits has been devised by Jesse E. Debrick, assistant foreman of signals on the Pennsylvania Railroad. The device for this purpose consists of two iron rods about the size of walking sticks which are connected to the two leads from a telephone receiver. An alternating current or a pulsating direct current is applied to one end of the wire to be tested and the opposite terminal of this power supply is grounded. In case the circuit being tested happens to have an accidental ground along its length the circuit will be completed by this means and a current will flow. In testing, the operator walks along the line and thrusts his two rods into the earth at points about a yard apart. As long as he is on the feed side of the ground in the power line, a noise will be heard in the telephone receiver. The tests are continued until the sounds cease. This indicates that the point of trouble has been passed for no current is now being picked up by the telephone terminals, these having passed beyond the return earth circuit. In a similar manner an open circuit may be tested, owing to the fact that there is a condenser action between the wire and the earth which sets up a flow of current through the receiver.

A Distinctive Road Form

ROAD forms for making concrete curbs are usually made of metal, but there is often some annoyance concerned with the method of locking the sections together firmly, as well as in the unlocking after the concrete has set. A Cleveland manufacturer has put on the market a form having a unique locking device designed to facilitate quick locking and unlocking. This consists of two very simple wedges so designed that it is impossible for the adjacent forms to get out of line on either their bottom or face. The lower wedge resembles a rerailing frog such as is used on derailed railway trucks in that the upper wedge is almost bound to fall into the correct position with regard to the lower, no matter how carelessly they are brought together by the workman. This makes the sections of road form practically self-alining and fool-proof, and facilitates the later process of edging. The sections are 12 feet in length and are made of 3/16-inch stock. The flat holding stakes have a penetration of 18 inches and may be driven in at any point along the edge of the form. The five-inch base of the form insures an ample bearing to support it when carrying mechanical finishing and subgrading machines during the progress of the usual road building operations.

A road form that stays put in line



The trouble, [illegible] its own location

This new machine grinds round holes accurately

A New Internal Grinding Machine

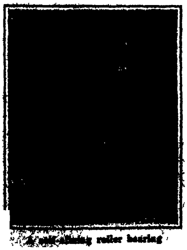
A NEW YORK maker of machine tools has placed on the market a new grinding machine, the invention of Fred E. Bright, which embodies a new fundamental feature in the form of a revolving and reciprocating work-carrying spindle in one bearing, eliminating the necessity for its exact alinement with other essential parts of the machine. This makes possible great accuracy in the finishing of straight round holes. The machine is intended primarily for manufacturing operations and grinds cylindrical holes only.

The grinding wheel spindle is direct driven by means of an inclosed silent chain from a 1½ horsepower induction motor, thus avoiding all slippage and maintaining accurately the wheel speed. Owing to the vertical position of the spindle, floor space is conserved and the use of motor drive eliminates belts and shafting, which take up space. The machine has an automatic feed, but can be fed forward in units of one ten-thousandth of an inch. Provision is made for dressing the abrasive wheel by lowering it against a diamond. The base conceals an oil-tank, with a pump for circulating the lubricant.

Roller Bearings for Railway Cars

ALTHOUGH the roller bearing itself is not by any means new, its application to the immense amount of railway rolling stock in this country has awaited the perfection of a bearing that would stand up to the extremely heavy duty required for such work, and be as safe and as free from the necessity of making frequent repairs as the ordinary type of plain bearing. Such a bearing as is shown here is applicable to use on flywheel shafts, heavy hoisting machinery and other similar work, but its greatest potential use is for the axles of railway cars. Experiments are now being made which are rather in the nature of tests of a type of self-contained, self-alining roller bearing for regular daily railway operation on one of our most prominent railroads. The bearing has held up in satisfactory condition after eighteen months of such service. Ordinarily this would constitute a fairly conclusive test, but for railroad service extremely conservative criteria are necessary. Given practical roller bearings on our railway rolling stock, bearings that have long since passed the experimental stage and which have demonstrated their ability to take hard punishment, the saving in fuel and efficiency, not to speak of cost of freight movement, will be enormous.

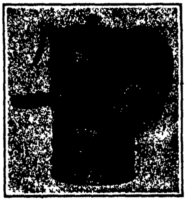
This unique bearing, which is made by a New York manufacturer, is self-alining by reason of its outer race, which is ground spherical on its inner surface. The rollers are barrel-shaped, with their largest diameter toward the inner ends. This permits of great freedom of movement between the inner and outer rings, which are always concentric on their bearing surfaces.



A self-alining roller bearing

Lights Without Matches

A MINER who finds himself far from the shaft at the end of a drift without matches is almost as good as dead. If his carbide miner's light has an automatic spark light its extinction is of no consequence—a quick motion of the hand, a spark is shot across the issuing acetylene gas and there is light. This is brought about by means of a flint and scraper. Such a light as this, which is made in Chicago, should be as valuable to night hunters, woodsmen, campers and farmers as to miners, because no matter how wet or windy the night the flint will ignite the gas. The light is primarily intended to be worn on the hat where it is always directed on the thing that claims the wearer's attention, but it may also be carried in the hand or worn on the front of the coat.



An acetylene headlight with self-starter

A Trackwalker's Kit Truck

THE man who daily patrols his section of several miles of railway track is able to carry only a spike maul and a long spanner. While these tools permit him to make most of the more urgent repairs necessary before the section gang arrives and completes the job, there are many occasions when the accessibility of a larger kit of tools would be of great advantage. But such a kit is altogether too heavy for one man to carry. From Germany comes a solution of the matter in the form of a small truck such as is used by section gangs on our own railways for moving ties over short distances. Mounted on this truck is a large toolbox containing a collection of rail repairing tools as well as an assortment of bolts, nuts, lockwashers, fishplates and spikes. This avoids the necessity of keeping these articles distributed more or less evenly along the right of way, as is now done in this country, in order that when needed by the track walker he is fairly sure of finding the desired replacement within a hundred yards of the job. These parts, when thus sprinkled along the track, are always subject to petty theft, as well as providing ammunition for boys with throwing propensities. When contained in the track truck they weigh one or two hundred pounds, but such a load may be pushed along the track by the trackwalker with less effort than that required for carrying the heavy maul and spanner. On the approach of a train it it is only necessary to tip the tool truck completely over, employing for this purpose the long lever ordinarily used to push the truck. The train having passed, the process is quickly reversed and the truck is again on the rails. It is provided with props so that the trackwalker may leave it standing when he stops to inspect or work.

Carries tools and spare parts for track repair

A De-bouncer for the Car

A SHOCK absorber must not deprive the springs of a motor car of their desired function of "letting the rider down easy," but they must prevent the annoying upbound which throws the rider into the air. Therefore they must act only on the upward motion of the springs, letting go instantly when the car body starts down. This function is well provided for in a type of shock absorber called a "checker," made in Cleveland for a well-known type of car. A roller acts, in this case, between the moving and stationary parts, wedging them together on the upthrow and having no function on the down go. An adjustable spring presses down the floating wedge to the degree desired. The upper clamp is attached to the forward ends of the sills of the car and the lower one bolts around the front axle. No holes need be drilled.

A Chemical Sponge for Refrigerators

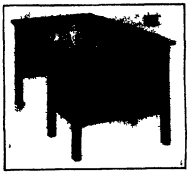
A PIECE of charcoal will absorb 8000 times its volume of gas and it is for this reason that charcoal is often taken for stomach trouble. Material having similar chemical properties is used by a New York manufacturer for filling a neat little chemical sponge for absorbing odors in the refrigerators, where milk and butter will so quickly absorb them if the chemical sponge is not provided. The article lasts about one season, but is inexpensive. Where the ice is impure it is impossible to keep the icebox perfectly wholesome between cleanings, no matter how frequent.

Absorbs bad odors in the refrigerator

A Blueprint Dryer with Thermostatic Control

EXPERIMENTS have proved that in order to pass wet blueprints through a dryer without wrinkling, it is necessary that the heat of the drying cylinder must be constant. This is a rather difficult thing to accomplish in a perfect manner. Therefore the application of a thermostatic control to a blueprint machine by a Chicago manufacturer is a distinct step in advance. The thermostat cannot forget. It might be said to "work if you fall asleep"! It is sensitive to slight variations in temperature and catches them before they become so bad as to be harmful. The result is a blueprint of uniform texture and freedom from wrinkles. The machine has a copper cylinder which it is claimed, will heat quicker, retain the heat better, and to which the prints will not adhere but will peel off automatically. The apron is made of asbestos and will not rot out because of wetness, like canvas aprons. The drive gives two speeds ahead, four and eight feet per minute, respectively.

A shock absorber on a different principle



This wastebasket attaches to your desk

Ball-bearings are used throughout, cutting operation costs and necessitating only a ¼-horsepower motor. Gas or electricity may be used for heating.

Road Construction Turntable Speeds Up Truckwork

ON road building jobs, owing to the narrowness of the space between the subgrades, it is generally necessary for trucks which have delivered a load of material to back up several hundred feet, or else to turn under their own power in the narrow space, which operation usually damages the subgrade. In addition, when trucks meet there is great confusion owing to the small space for maneuvers. Therefore a turntable for turning trucks, which is made in Pittsburgh, meets a need. The turntable occupies a space of eight feet at one side of the road. In turning, one end projects over the road forms. This means that an outgoing truck has free way to pass the turntable at all times, and that the forms remain in place regardless of the operation of the turntable. It is mounted on a skid which enables it to be moved from place to place without tearing up the subgrade. The turntable is attached to a returning empty truck and moved the required distance without any loss of time.

A truck, after being driven on the turntable, is secured from tipping by supports at either end of the table. When the truck is ready to be turned a lever is operated which folds up these supports and then acts as a push bar by means of which one man can turn a 5-ton truck loaded with four yards of material. The runways which support the truck are mounted on a circular track of smaller diameter than the width of the truck. This track is placed immediately above a similar track rigidly secured to the skids. Between these tracks is a series of rollers so that there are no axles to cause friction. A center pin rigidly secured to the skids which support the lower track holds a spider which keeps the rollers in place and also holds a central bearing for keeping the upper track properly centered.

A practical turntable which saves time for the contractor

Drying Negatives Without Clips

PUTTING a large number of negatives into ordinary clips for the purpose of drying them takes time and often damages the negatives by scratching them. It is much easier to pinch them between the coils of a long spiral spring made by a Philadelphia manufacturer for this purpose. These have room for a large number of negatives and their insertion requires only a movement of the fingers in bending the spring.

A simple device for holding drying negatives

A Waste Basket for Careless Marksmen

ONE of the most irritating habits of wastebaskets is to place themselves where they weren't, yesterday or the day before. The busy office worker without looking up, aims his waste paper where the basket ought to be and so the floor soon takes on the general appearance of a paper mill. To conquer all these annoyances a Westfield, Mass. manufacturer has devised a wastebasket which may quickly be attached to the end of a desk, or, if desired, underneath it. Here it always stands—or rather, hangs—and random shots at it hit the target because it is always there. The desk-end type shown in the illustration hangs from a small bracket attached to the under side of the desk top ledge. The under-desk type, which is not illustrated, hangs from a rod which has a spring, causing it to thrust its respective ends, each of which bears a rubber tip, against the opposite sides of the space beneath the desk. The baskets are made of metal and make desirable additions to the furnishing of bathrooms for clean and soiled towels, of kitchens as catch-all and of libraries as receptacles for magazines and papers.

A Simple Seed Drill

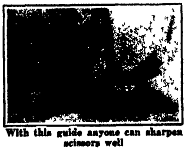
FOR the average home garden a seed drill is often a luxury that seems hardly warranted by its small area, as well as an inconvenience owing to the two long handles being in the way at the ends of the short rows near the fence or wall. On the other hand, the dropping of seeds from the hand in a drill or trench is easily done poorly, but is with difficulty done well. It is as necessary to space the individual seeds somewhat uniformly and to drop them singly instead of in dense groups as it is to see that no large gaps are left. The gardener often begins the sowing of a long row by hand with good intentions of using care in order to forestall the troublesome thinning later on, but finishes with an impatient rush, for spacing the seeds evenly is very tedious.

A novel and practical seed-drill for the home gardener

A simple hand seed drill which comes to us in the form of a photograph from Germany and which is neither cumbersome nor expensive just fills the need of the small gardener in this respect. It consists of two seed hoppers which are attached to a cross-bar in an adjustable manner, permitting proper separation of the rows in sowing such vegetables as, for instance, lettuce which is grown in double rows closely spaced. In order to feed the seeds into the rows steadily and evenly a spindle passes through the throat of the hopper just above the shoe that runs along in the ground and distributes the seeds. This spindle, which is provided with the recesses necessary to contain and pass out the seeds one by one, and which is adjustable for various sized seeds, is actuated by a wheel running on the ground. To prevent it from slipping, it has around its periphery a number of spikes. A handle may be attached to the entire apparatus and adjusted to the desired angle by means of a wing nut.

A Practical Scissors Sharpener

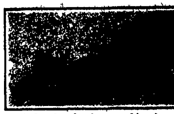
SHARPENING a pair of scissors consists in making a 60-degree cut across the edge of the blades, but it is very essential that the proper angle and no other be given. Moreover, it is necessary that the same angle be given along the entire length of the blade. In order to enable the scissor blades to be held at this angle, not only on one stroke of the sharpening but on every one, a Chicago manufacturer has put out a simple little device consisting of a piece of sheet metal bent in the form of a guide for the blade. This prevents the accidental ruining of the work, however carefully done without a guide, by a stroke at a greater angle with the side of the blade than the proper one. Added to these qualities is the unique fact that the device may be used in conjunction with any flat whetstone the user happens to have on hand. A woman can use this little sharpener as well as the average man, and a man can use it as well as a mechanic.



With this guide anyone can sharpen scissors well

A Clinging Grip on the Steering Wheel

A RUBBER grip for the steering wheel of the motor car permits the driver to retain full control of the car with little expenditure of energy, due to unconsciously gripping the wheel until the hands become tired and numb. This is especially true when the driver is wearing gloves, as the hands then slip very easily on the polished surface of the wheel. The rubber grip stretches around the wheel, fitting securely and resembling a new bicycle tire. It is made in Chicago.



A handy shaving combination

Lather: Rub-It-In

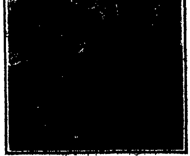
WHEN the barber lathers you he rubs it in with his fingers, but when you shave yourself and want to rub the lather in there is nothing to it but a mussy job—unless you use some such a rubber-in as shown in the picture. Here is a regular shaving brush which you proceed to use in the regular manner. Then, by manipulating a little slide in the handle, the brush is drawn into the shell, like a turtle's neck, and the lather is automatically squeezed out of the brush onto a rubber pad having dozens of little fingers. These do the rubbing. The little stud which actuates the brush in its tube locks in the desired position at either end.

A Non-Metallic Automobile Body

THERE recently has appeared a fabric type of automobile body which uses a wooden frame and dispenses with metal panels altogether. A New York textile company has produced a waterproof leather cloth of a lustrous finish, which is applied over a wooden body framework dressed with a coarse wire fabric and the necessary padding to deaden rattles and squeaks, as well as to fill out curve lines, etc. It is claimed for this new type of body, which has been shown at recent automobile shows, that the cost of the raw material is approximately one-half of that used in a metal body, that the time required in making a cloth body is one-third of that required in metal construction; that the cloth panels weigh only one-half as much as metal panels and that the finish is equal in smoothness, luster and brilliancy to that of a metal body. It is also claimed that the leather cloth lasts longer as regards finish than the usual finish of a metal job.

Radiant Type of Gas Heater

THAT the radiant type of heater was first adapted to the use of gas is the contention of a reader of the SCIENTIFIC AMERICAN, who states that the first development of a radiant heater suitable for household use was made in England two or three years before the war. This heater was equipped with gas burners which heated to a high temperature a refractory material formed in the shape of a lacework surrounding a tubular space over each flame, and raised by the flame to incandescence. However, their manufacture was stopped by the war, the factories being taken over for war work. It is said that they are now in use all over the country.



An easy way to avoid tired wrists

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

New Element, Hafnium, Discovered by English Chemist

AN English chemist has discovered a new element, which has been given the name hafnium. The element was isolated from a black sand, which came from New Zealand. This sand contained a certain proportion of titanium dioxide, and when this constituent was removed from the sand and examined by itself, it was found to contain a refractory residue. Further examination of this residue revealed it to be an oxide of a new element, closely related to titanium. The name hafnium, which is derived from the name of the city of Copenhagen (hafnia), was given the new element. It is said that the black sand deposits in New Zealand, from which the sample of sand was taken which was used in the experiments, is more than seven miles in length and of unknown depth, so that if the new metal, hafnium, is found to have important commercial properties, it can be produced in bulk. It may be of considerable value in the making of incandescent mantles, as may be inferred from its analogy to the metals zirconium and titanium.

New Steel

THE English firm, Vickers, has produced a new steel, which has the following composition: 60 per cent nickel, 12 per cent of chromium, 2 per cent of manganese, 0.5 per cent of carbon and 20.5 per cent of iron. This nickel chrome is not oxidizable, that is, it will not rust. It was tested under the most severe conditions and was found to withstand corrosion under a pressure of 1000 atmospheres and a temperature of 600 degrees Centigrade, the duration of the test being 4000 hours.—*Chemiker Zeitung*, 1922, page 1169.

Process for Conserving Sandstone

AN interesting process for the conservation of sandstone, in which a silicate preparation was used, was described in the November 22 issue of the *Proceedings* of the Royal Academy in London.

Industrial Products From Acetylene

IN an address before a meeting of the French society, Societe de Chimie Industrielle, Prof. A. Guyot gave an interesting paper on the industrial syntheses starting with acetylene. Aldehyde can be converted into metaldehyde and paraldehyde. The latter is an important liquid fuel and should eventually reach a stage of great commercial importance because it can be produced more cheaply than alcohol derived from calcium carbide. It was also pointed out that processes were being studied on a semi-large scale to utilize the ethylene from coke-ovens for the manufacture of alcohol.

Effect of High Pressures

RECENT experiments have been made to determine just what effect extremely high pressures would have, that is, pressures reaching to 20,000 atmospheres or approximately 300,000 pounds per square inch. Under such pressures gases are made to pass through metals, liquids become compressible and with the exception of mercury do not penetrate through metals. Under a pressure of 12,000 atmospheres paraffine and rubber become harder than soft steel and phosphorus becomes black, non-combustible and a good conductor of electricity. The new properties are stated to exist after the pressure is removed.—*Jour. Soc. Chem. Ind.*, 1923, page 80.

Making Artificial Pearls and Precious Stones

ACCORDING to German Patent No. 350,903, the interior or black surface of the pearl or stone is coated with a suitable phosphorescent material, so that color changes are produced when the pearl or stone is taken into a dim light. For example stones treated with zinc oxide containing radium exhibit a color similar to that of Guignet's green. In the case of glazed pearls, the phosphorescent coating is protected by a transparent varnish against atmospheric effects, and the glaze, if it is liable to be attacked by the radium compound, is similarly protected.

Utilizing Oat and Peanut Hulls

IN the manufacture of oatmeal and of peanut butter and oil, a large quantity of oat hulls and peanut hulls is obtained as by products. These by-products are generally used as filler for stock feed, burned as fuel or allowed to go to waste. It has been found that a crude sugar sirup can be obtained by hydrolyzing these by-products with two per cent of sulfuric acid for two hours at a pressure of 15 pounds per square inch. After hydrolysis the acid was neutralized with milk of lime and the sugar was removed by pressing and washing the insoluble residue. About 26.5 per cent of glucose was obtained from the oat hulls by this method and about 7.6 per cent from the peanut hulls.—*Jour. Ind. Eng. Chem.*, February, 1923.

Drying Wood

ONE of the greatest difficulties in the wood industry lies in the drying of the wood, the seasoning process. Wood is difficult to dry because the small cellules deep in the wood remain alive for a long time and a living cell does not easily lose its water. It can only lose its water after it has been killed by the action of a gas or vapor. Accordingly fresh wood was subjected to the action of the vapors of benzine in an autoclave. The cellule was killed in this manner and under the action of hot air the drying of this wood then took place very rapidly.—*Jour. Ind. Eng. Chem.*, February, 1923.

Fertilizing Forest Land

IT has been generally held that wooded land, land covered with forests, should not be fertilized for there would be no resulting increase in the growth of the trees. This has been shown to be erroneous, as treatment of such land with fertilizers containing nitrogen, potash, phosphoric acid and lime has increased the growth of trees in many cases. A test, extending over a period of 14 years, was carried out at Owing, Sigmaringen, on the slopes of the Jura Mountains, where a stretch of land that contained only a few pine trees and juniper bushes, and which had been used for some time for pasturage was divided into two parts, one of which was treated with nitrogenous fertilizer and sown with Swedish clover. Both parts were then planted with firs and divided into sections some of which were completely and others partially fertilized while others were left unfertilized. Between 1906 and 1920 the average increase in the height of the trees in the sections treated with Thomas meal and kainite was 523 centimeters, in those treated with Thomas meal alone 513 centimeters, and in the untreated sections only 408 centimeters. Ground burnt lime by itself effected very little improvement in the growth. Trees in the sections planted with clover showed a very considerable increase in growth, especially in the first year, but the tests on the whole showed that equally good results may be obtained by the use of mixed fertilizers without a previous crop of leguminous plants.—*Jour. Soc. Chem. Ind.*, Feb. 2, 1923.

Paper From Black Butt Pulp

THIS pulp is made from a tree which is indigenous to Australia. Considerable experimentation has been done with this pulp in order to determine whether it is not possible to use it in the place of sulfite pulp, which at the present time is imported into Australia. It was found that 65 per cent of black butt pulp, 25 per cent of imported sulfite pulp and 10 per cent of waste paper made a very good grade of cream colored laid paper. Black butt timber gives a higher yield of pulp per cord than any other wood used at the present time for pulping purposes. Furthermore, the treatment is comparatively low.—*The World's Paper Trade Review*, Dec. 29, 1922.

X-Rays Used to Activate Catalysts

WHAT appears to be a new use for X rays or Roentgen rays is discussed in the *Zeitschrift fuer Elektrochemie* 1922, pages 472-3. Platinum catalysts, such as are used in the contact process of making sulfuric acid, are subjected to the action of the rays. They are made more active so that the production of the acid is increased to a material degree. At a temperature of 400 degrees Centigrade, for example the yield of sulfur trioxide increased from 94.6 to 95.9 per cent and at 200 degrees Centigrade from 35 to 51 per cent. The activation is not permanent but gradually disappears within 24 hours after the catalyst has been treated with the rays.

Erasing Inks

AN interesting account of inks and their erasibility is given in the Anales asoc. quim. Argentina, 10, 220-8, *Chemical Abstracts* 1923, 476. The only indelible inks are those containing carbon. It was found that solutions of potassium permanganate followed by sodium hyposulphite are much better ink eradicators than sodium hypochlorite and oxalic acid, as are commonly used. The former eradicator will work on aniline inks which the latter sometimes does not eradicate.

New Weapons for Boll Weevil Fighters

THE fight against the cotton boll weevil, which causes stupendous damage to the cotton crop each year the combat to exterminate the "billion dollar bandit" as it is called, goes on uninterruptedly. Recently new weapons have been developed to assist in this perpetual battle. For one thing poison gases the military weapon developed during the war, will be utilized for peaceful purposes in the warfare on the boll weevil. Another suggestion was the use of X rays stored in chemical salts and applied by adhesive mixtures to the bolls and squares of the cotton plants to sterilize the eggs of the insects.—*Oil, Paint and Drug Reporter*, Feb. 26, 1923.

Motor Fuel From Vegetable Oils

VEGETABLE oils can be converted easily into gaseous and liquid hydrocarbons by subjecting the former to catalytic processes. The gaseous products are hydrogen, methane, etc., while the liquid products, after neutralization and hydrogenation, form a mixture containing appreciable amounts of benzene toluene and meta xylene. This forms a good motor fuel with a very agreeable odor.

Sugar Cane Alcohol, a Gasoline Substitute

ACCORDING to the *Oil, Paint and Drug Reporter* of March 26, 1923, sugar cane alcohol is used in South Africa as a substitute for gasoline. It is claimed to give more power than gasoline and to enable the engine to be started more easily. The engine will start quickly in cold weather.

Self-Lubricating Gasoline

ACCORDING to the *Engineering World* March 1923, a self lubricating gasoline has been developed in California which possesses certain advantageous properties to recommend it to the motor car owner. Ordinary lubricating oil is treated with a chemical and then the treated material is added to the gasoline in the proportion of one gallon of the treated oil to 500 gallons of the gasoline. It is claimed that this product will increase the mileage obtained from a gallon of gasoline approximately 25 per cent. The lubricant introduced in this manner, penetrates to every part of the gas engine cylinder and lubricates the upper parts of the same which are not touched by the oil, fed to the cylinder in the ordinary manner. Friction is thus reduced to a minimum and due to the elimination of excessive heat and pre-ignition, no carbon is formed. It is claimed that the gasoline mixture develops perfect atomization in the carburetor.

Crucible Steel in a Hearth Furnace

A HEARTH furnace, which is capable of turning out a steel able to compete with high grade crucible steel, is the invention of a Swiss engineer. This furnace has been installed in a foundry in Germany. A very high temperature is attained in the furnace by the joint action of heated fresh air and gas generated in a producer. The gas is burnt most rapidly due to the hot air and the narrow flame coming from the white heat section of the producer. The whole contents of the furnace are poured out into a large ladle raised to a white heat, which enables any sample up to 1.5 tons in weight to be cast in the most complicated molds without any premature cooling. The tenacious and substantial steel castings obtained by the new process will in many cases be a good substitute for bronze as well as complicated forgings.

The Heavens in July, 1923

Something About the Methods and the Results of the Einstein Verification

By Professor Henry Norris Russell, Ph. D

ONE outstanding achievement of observational astronomy at the time these words are written, justly takes the foremost place in our interest This is, of course, the precise and conclusive confirmation of Einstein's predictions by the observations of the Lick Observatory party at the Australian eclipse of last September Full details were made public by Dr Campbell a few days ago, at the meeting of the National Academy of Sciences, and some account may reasonably be expected by our readers.

We all know, by this time, how Einstein predicted from his theory of general relativity that rays of light passing near any gravitating mass should be slightly curved The calculated influence of the planets is too small to measure, but that of the sun is considerable A ray which grazes its surface should be deflected by 1 75 inches one passing twice as far from the sun's center, by half this amount and so on—the deflection being inversely proportional to the central distance

Now on a modern astronomical photograph one second is a large quantity, which stands out at once in the measures, so that it might appear easy to test Einstein's prediction by photographing stars around the eclipsed sun But the thing is not quite so simple as it looks Granted that we have a total eclipse, observable from a region where the weather chances are good, and actually get our photographs, we find ourselves faced with a number of practical questions.

In the first place, what are the normal positions of our stars in the heavens, from which the Einstein effect seems to shift them? This we can answer by taking an other photograph of the region—or better a set of plates—at some other time of year when the stars can be seen at night and their light passes nowhere near the sun We have then to compare an eclipse plate with the others, and to hunt for the shift

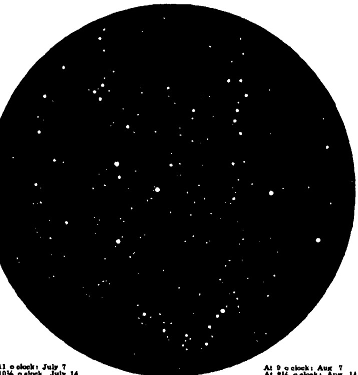
But this again is not as simple as it looks, for our two pictures may not be on the same scale owing to changes in the length of the telescope, or in the focus of the lens, making the same group of stars look bigger on one set of plates than on the other Now the Einstein shift seems to displace the stars outwardly, away from the sun The two displacements, however are not alike, for the change in the telescope increases all distances on our plate in the same proportion and therefore affects the outer stars most, while the Einstein shift is greatest for the stars nearest the sun If we measure, on our plates, some stars that are close to the sun, and others at greater distances, we will then be able to disentangle the two effects—at the cost of some loss in accuracy

A worse difficulty arises from the refraction of light in our atmosphere, which shifts the apparent positions of the stars, some more than others, by amounts which vary with their altitudes above the horizon To reduce this trouble to a minimum, we must take our night plates at an hour when the stars occupy as nearly as practicable, the same apparent positions in the sky, compared with the sky and the meridian, as they did at the time of the eclipse The small outstanding differences may then be calculated and allowed for

The Details of an Intricate Task

So far we have assumed our instruments to be perfect, and in exact adjustment, but like all human devices they will actually be imperfect We cannot hope to make them absolutely free from errors the best we can hope for is to keep these errors the same at the various times when all the plates are taken—in which case an error in the position of a given star on one plate will be the same in all cases, and will drop out of the difference between the eclipse plates and the night plates, upon which difference our calculations are based To be as sure of this as we can, every part of our apparatus—lenses, telescope-tube, plate-holders and the like—must be constructed, not merely with the utmost accuracy, but with great rigidity and stability so that when set up in different places and at different times, we can get all the adjustments to be in practically the same state Any minute outstanding errors - such for example as might arise if the plate were not exactly at right angles to the optical axis of the telescope—can be allowed for in the calculations, but on this account the calculations become rather intricate, and very laborious, though they can be made as accurately as ever

The British expeditions to Brazil and West Africa in 1919 set out so soon after the armistice that it was impossible to secure apparatus which satisfied all these exacting requirements, and the plates which they obtained, while proving beyond a doubt that rays of light passing near the sun were deflected, and to about the extent predicted, showed also some small deviations, doubtless of instrumental origin, which have given rise to much discussion (more in the writer's opinion, than was justified by the circumstances of the case.)



At 11 o'clock: July 7
At 10½ o'clock July 14
At 10 o'clock: July 22
At 9½ o'clock July 30
At 9 o'clock: Aug 7
At 8½ o'clock: Aug 14
At 8 o'clock: Aug 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

The Lick Observatory expedition, with ample time for preparation and under the master hand of the veteran observer Campbell, secured equipment which answered to the most exacting tests The lenses were specially designed to give sharp images over a wide field, the mounting was all of metal, and combined the necessary lightness with great rigidity, the instruments were pointed directly at the sun, avoiding the troubles that may arise when its rays have to be reflected from a mirror, and every part was provided with precise and ingenious means for bringing it into exact adjustment, and then clamping it firmly in place

To secure a high sun and good chances of weather, the expedition proceeded, as all the world knows, to the almost inaccessible northwest coast of Australia, between the desert and the sea. As it was impracticable to stay there for months and wait until the same stars could be seen in the night sky the night observations were secured in the island of Tahiti, which is in almost the same latitude, and a second group of stars, which could be observed by night at both stations, was photographed on the same plates, as a check.

This careful and laborious preparation was fully justified by the results. Four excellent plates were secured during the eclipse, and as many more for comparison. Then after the astronomers returned from their journey half around the world, began the laborious and tedious work of measurement and computation —how tedious, only those who have done similar things can fully know

From 60 to 80 stars were measured on the various pairs of plates. Each star gave an equation involving seven unknown quantities, and all these equations, for a given plate, had to be set up, combined and solved—which meant, literally, weeks of labor The final results, however, richly justify all the pains and care. Three of the four pairs of plates have so far been worked up—independently by Professor Campbell and Dr Trumpler and each plate shows the Einstein effect, clearly and without question. The amount of the shift, expressed as the calculated influence for a star at the very edge of the sun, where, of course, none was observed, came out with values ranging from 1.59 minutes to 1.86 minutes for the various plates, the small outstanding differences arising from the minute and inevitable errors in the positions of the faint-star images on the plate, and in the measurement of these images. The general mean of all the results reduces to a deflection of 1 74 minutes at the sun's limb, as against 1 75 minutes predicted by Einstein. A more complete and satisfactory observational confirmation could hardly be imagined, and the world's congratulations are due, both to the great mathematician who developed the theory, and to the great astronomer who has so conclusively confirmed it.

The Heavens

The summer constellations are now seen at their best. Scorpio and Sagittarius are in the south, amid the splendid mass of star-clouds which marks the direction of the center of our galactic universe Following up the Milky Way we come to Aquila and Cygnus, with Lyra to the west, nearly overhead, then down through Cepheus and Cassiopeia to the horizon In the east the most conspicuous group is Pegasus, in the southwest are Virgo and Libra, with Jupiter and Saturn brightening them up, in the west Boötes and Hercules, the latter high, in the northwest Ursa Major, in the north, Ursa Minor and Draco.

The Planets

Mercury is a morning star at the beginning of the month, and rises before 3 30 A. M He soon draws nearer the sun and passes through conjunction on the 21st, so that during the latter part of the month he is invisible.

Venus is a morning star, rising at 3 40 A. M. on the 15th, and conspicuous before sunrise She is close to Mercury at the beginning of the month being only three-quarters of a degree away on the 4th, but later draws off to the westward.

Mars is an evening star, and is getting very close to the sun. He sets about 9 P M. on the 1st, and is still visible in the twilight, but by the end of the month he is lost to sight

Jupiter is in Libra, visible all the evening and the most conspicuous object in the heavens next to the moon Saturn is farther west, in Virgo, and comes into quadrature with the sun on the 6th, after which date he may be counted as an evening star By the end of the month he is lost to sight shortly after 10 P M.

Uranus is on the borders of Aquarius and Pisces, and crosses the meridian at 3 42 A M. on the 15th. Neptune is in Cancer, and altogether too near the sun to be observable.

The moon is in the last quarter at 9 P M on the 5th, new at 8 P M on the 13th, in her first quarter at 9 P M on the 20th, and full at 6 P M. on the 27th. She is nearest the earth on the 21st, and farthest away on the 7th During the month she passes near Uranus on the 3rd, Venus on the 12th, Mercury on the 13th, Mars on the 14th, Saturn on the 19th, Jupiter on the 21st, and Mars again on the 31st.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Advantages of Bolted Chassis Parts

WHEN we remember that the frame work of the motor truck is really the foundation of the whole machine, it is surprising that so few machines show any real evidence of applied engineering thought and effort. Practically any repair man will verify this by pointing out that the average chassis coming into his hands for overhauling is as loose as the proverbial basket. In a large measure this is directly traceable to the use of rivets throughout the frame assembly, and their inability to withstand the constant racking and vibration of motor truck operation. As far as we know there are only one or two manufacturers who have given this phase of design the amount of attention it warrants. One of them, a Buffalo manufacturer and incidentally one of the pioneer motor truck manufacturers in this country, has been using a bolted frame with outstanding success for seven years.

In their method of fabrication all brackets, cross-members, supports and in fact everything attached to the frame side rails is held in place by bolts and heavy type lock washers as shown by the accompanying illustration. The bolts are of ample size and fitted with threads which are held to very accurate limits to assure close fitting nuts. Actual service has proved through years of use and thousands of miles of travel that this method practically overcomes chassis looseness. And in event that play ever develops, it is a much more simple matter to draw up on a bolt or two than to chop out loose rivets, drill the next size larger holes and insert new red hot rivets.

Another point, which while of secondary importance in truck life is nevertheless a decided advantage, is the ease with which repairs can be made. For example, collision damage with broken fender brackets, bent step hangers or even damaged frame rails lends itself readily to dismantling and replacement with a minimum of labor and expenditure for parts. The chief reason that this design has not been more generally adopted is the tendency of manufacturers to cut down their production costs in order to maintain the lowest possible selling price. Experience with motor trucks, however, will prove repeatedly that the cost of a motor truck is determined by its cost of operation rather than its initial purchase price. Therefore, this design is of particular interest because it goes such a long way toward eliminating this source of chassis looseness. To bear out the perfection of this design, the only passenger car using a bolted frame similar to that of the truck is a very costly English car.

Details of the assembly of the bolted truck-chassis

Suggested Motor Truck Size Limits

SHALL dimensions, weights and speeds of motor vehicles be reduced to the capacity of the weakest parts of the weakest highways and roads, or shall the roads be brought up to the standard of improvement adequate to carry the biggest, heaviest and swiftest loads that users of motor vehicles desire to put upon them? These are the questions asked by the Motor Vehicle Conference Committee in a digest of State laws in force on January 1, 1923, presented in a pamphlet together with a suggested code of regulations for uniform State adoption.

The committee, composed of representatives from the American Automobile, Motor and Accessory Manufacturers' and National Automobile Dealers' Associations, and the National Automobile Chamber of Commerce and the Rubber Association of America, believes that between the two extremes presented by the questions it asks a compromise will be found. This would affect the manufacturers in that they would design their products and highway engineers would build their roads in accordance with certain specifications evolved to meet the need. In regard to size restrictions the committee recommends a width, including load, of 96 inches; height including load, of 12 feet 6 inches; length, including load, one vehicle 30 feet, combination of vehicles, 85 feet. Weight restrictions—single unit, 28,000 pounds.

Why Trucks Should be Loaded to Capacity

ONCE more in the history of the automotive industry it has become necessary for motor truck owners to plan maximum loads, if they are to cure for the transportation needs of the country during the next year. It is freely admitted that there is at the present time a shortage of freight cars almost equal to the war time lack and during the next year this shortage of transportation facilities will not be relieved to any great extent. It is apparent, therefore, that the motor truck, as before, will have to come to the aid of the railroads to meet a greater demand for movement of goods from all classes.

The railroads of the country are exerting every influence to insure that all freight cars are loaded to capacity and that empty mileage is reduced to a minimum. In conjunction with this we have many truck owners who operate fleets, such as moving vans and cartage lines and trucks for hauling farm produce to city markets. In many cases these men are operating their trucks to full capacity in both directions. But there are some truck operators, perhaps many of them, who have forgotten the return load propaganda of war time. A careful analysis of the transportation field will show them that even today we have reached such a stage in the railroad freight situation that it is impossible for business men to ship when, where, and as they like. The motor truck during 1923 can be of great aid in helping to solve this problem and there should be no trouble in securing capacity loads going and coming if a little effort is made. Such an effort is not only due the business of the country, but it is also due the truck owners. They are doing themselves an injustice when they do not carry all the goods they possibly can in both directions on every trip. And not only are they doing themselves and their business an injustice but their one way loads are an economic loss that affects everybody in the price to the consumer.

Economy in Small Wheels and Large Tires

A NEW development appears in the automotive industry in the small diameter wheel with the large oversize tire having its sponsors claim, many advantages over the present sizes of pneumatic tires. It was pioneered by a taxicab manufacturing company of Chicago which has given it a thorough tryout in its testing laboratory and also in road service because the company operates more than 1000 vehicles. The cab is built and operated on a cost per mile basis that is not equaled, it is said, in the automotive industry.

It was with this in view that two years ago the company started experimenting with the small diameter wheel and the large oversize tire. Today cabs going to the large municipalities are equipped with a 29-inch wheel, with either a 29 x 4½ or a 30 x 5-inch tire. Several tire companies now manufacture these sizes. In addition to these two sizes, the tire companies are conducting experiments with other sizes of big oversize tires. On a 20-inch rim the following tire size will fit: 29 x 4½ inches, 30 x 5 inches, 32 x 6 inches and 34 x 7 inches. Decreasing the wheel size and increasing the cross section diameter of the tire decreases "unsprung weight." The improved riding qualities, it is claimed, are so marked that other improvements, soon to be announced, will make the public feel that the cabs are springless. The present development marks the passing it is claimed of shock absorbers, rebound checks and similar devices which have come into existence in an attempt to make driving more comfortable.

With the new type tire it is claimed there is no lost energy, every explosion is translated into travel. There is also less wear and tear on the tires. With the large new oversize tires the car, it is reported, literally floats along on a cushion of air—the resiliency is so marked that all road inequalities are smoothed out by the tires themselves. Travel over rutty country roads, it is said, is without terrors while the danger of skidding, even without chains, is practically nullified. An additional advantage is the ease with which sand and mud can be surmounted.

In the tire size as created the air pressure is less, the life is longer and the general advantages many. A 34 x 7 tire on a 20 x 4½ rim weighs only 68 pounds including the wheel, tire, tube and flap. In experiments conducted by the cab company in Chicago 29 x 4½ inch tires have thus far given 14,000 miles of service and are still good for many more, and it is further pointed out this is regular service for these tires, not special cases picked out. Gasoline consumption in the oversize tires has been decreased from 3 to 5 miles per gallon, not only in tests with the cabs but also with passenger cars, according to the authority we have quoted.

Saving Fuel Important

THE recent stir in the daily press about the possibility of gasoline selling for one dollar per gallon has directed public attention to the necessity of saving fuel in every way possible. Here is a suggestion to drivers for the saving of gasoline which may be small in amount for a single day's run but which will be worth while in a year's driving. The common practice of waiting to shift gears on hills until the vehicle has almost come to a stop is one of the causes of waste of small amounts of gasoline. Tests were made by a government bureau primarily to discover the effect of various kinds of highway surfacing material and different grades on gasoline consumption. The conclusion with reference to faulty driving is merely incidental to the tests, but it is one which will mean a small saving to every owner if the advice of the bureau is heeded.

The vehicles used in the tests were equipped with an ingenious device which makes a continuous record of the gasoline consumed as the vehicle moves over the road and another which makes a simultaneous record of the speed at every instant. Suitable sections of road were selected for the tests and the exact grades of these sections were determined. The specially equipped vehicles, both trucks and cars, were then driven over the various sections taking the records of the gasoline consumption and speed with the two instruments referred to. Several trips were made over each section, and the rate of fuel consumption and speed for each trip were plotted on a graph with the profile or grade of the road. It is these diagrams that show the effect of delayed gear-shifting.

Exact instructions for the most economic driving will vary with the make of the truck or car but the following pointers will be of value to all. In ascending a hill do not wait until the last second to shift to a lower gear. If you do you will not only lose speed and overtax your engine but you will also consume more gasoline. On one of two trips of a one-ton truck the gears were shifted at a speed of 10 miles an hour and on the other at a speed of five miles an hour. In the two trips over the same stretch of road with a truck having a total weight of a little over four tons the average speed was approximately the same in both cases. In one case gasoline consumption was at the rate of 4.2 miles per gallon and in the other 3.5 per gallon. With more knowledge concerning economic driving a considerable reduction can be made in the 4,000,000,000 gallons of gasoline consumed each year.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

BUCKLE.—C J DAHLGREN, 212 Broadway, New York, N Y The object of this invention is to provide a buckle more especially designed for use on trousers and other garments, and arranged to insure a positive hold on a strap or the like and without having the points of the tongue projecting to become liable to tear overlying clothes or injuring the fingers of the user

Chemical Processes

THERAPEUTIC COMPOSITION — R. SANSEVERO, 167 Sterling Place, Brooklyn, N Y The invention relates to a composition for the treatment of diseases. The general object is the provision of a compound having bactericidal and penetrating properties for the treatment of disease by local applications. A further object is the provision of a composition which upon application liberates a penetrating antiseptic agent. The composition comprises sodium glycocholate, solargentun-squibb and hexamethylene tetramine

COMPOSITION OF MATTER FOR CLEANING CRYSTAL AND GLASSWARE.—JULIA E. GROVER, c/o W H Jayne, Jr, Lakewood, N J The invention has for an object the provision of a composition which is economical to use, simple in preparation, and highly efficient in its cleansing and polishing function when used on glass, china and crockery The composition is formed by mixing and boiling substantially sal soda, borax, sulfur oil of citronella, alum chlorinated lime glycerine and water

Electrical Devices

AUTOMATIC TURN OFF SWITCH.—L S FOLTZ, 911 Wattaw St., Lansing, Mich The invention has for its object to provide a switch adapted for interposition in electric lighting or heating circuits, and controlled by the passage of the current for shutting off said current at the end of a predetermined time, wherein the switch mechanism is connected to an expansion chamber which when it is expanded by heat opens the circuit.

CONTROLLING SYSTEM FOR MINE BLASTING OPERATIONS.—S F BRIDWELL and J F KENNEDY 812 Wabash Ave., Terre Haute Ind The invention relates to mine blasting operations in which a plurality of blasting shots are electrically fired in the different work places of a mine at one operation To overcome the difficulty of knowing if all the cartridges have been exploded and thus avoiding accidents to the workmen the system includes a telephone whereby the operator may positively know whether or not a particular cartridge has exploded

RECEIVER. — E. REISZ, Zehlendorf Mitte Germany The invention relates to electrical receivers, and has particular reference to a magnetic receiver An object is to provide a receiver in which the disposition of the mass of the armature is disposed so as to have a maximum sensibility for a given magnetic field, and in which the vibrations of the diaphragm respond to the magnetic variations of the circuit with maximum efficiency and minimum expenditure of magnetic energy

PROCESS OF REGENERATING LEAD STORAGE BATTERIES.—H O PARKER, c/o R. L. Barnum, Simpson, Kan An object of the invention is to provide means for regenerating or desulfating sulfated lead storage batteries which have lost their efficiency, thus permitting indefinite or re-use of batteries which might otherwise be discarded. The process consists in removing the sulfuric acid, washing the batteries with pure water, filling the same with a solution of an hydroxide, and charging the battery until the solution becomes acid.

BURGLAR ALARM.—J J BERRY, 69 Avenue A, New York, N. Y An object of the invention is to provide a simple, compact and strong alarm device which can be readily attached adjacent any type of door, and which will be operated after having once been set whenever any person moves the door to produce a signal, operate an electrical circuit to ring a bell, illuminate a light or perform other electrical indicating functions.

Of Interest to Farmers

SILO.—J MATTSON, 153 W Chestnut St, Chicago, Ill. An object of the invention is to provide a silo having a flexible closure which is supported by a rigid frame so that the closure is concave when supported by the supporting member and may be readily lifted and lowered in the silo. A further object is to provide a silo having a closure in which a door is disposed, thereby permitting access to the ensilage from the top of the closure.

ATTACHMENT FOR USE WITH TRACTOR-DRAWN BINDERS.—C. F REED, Palmyra, Neb. The invention relates to means for actuating the binder tilting means, the reel raising and lowering means and the bundle discharging means. The general object is to provide an attachment adapted to be interposed between the binder and tractor to be accessible by the tractorman positioned at the rear of the tractor, whereby the binder may be completely controlled, thereby avoiding the necessity of having a man on the binder

ANIMAL POKE.—B. F C. MORRIS, Morris Mfg Co., El Reno, Okla. This invention has for its object to provide a device which is adaptable to various animals, which can be worn by the animal when not in operation with ease and comfort and without irritation, and which when in operation is effective to properly retard and restrain the animal The device is simple and durable, and inexpensive to manufacture.

EGG CASE.—E P WATSON, SR., Bentonville, Ark. The invention relates to egg carrying cases wherein the eggs are supported in groups. An object is to provide an egg case in which bumpers are provided exteriorly for taking up a certain part of the shock when the case is dumped down, and which contains independent springs arranged interiorly to support the respective groups of containers.

BEET TOPPER.—H. L SPARKS, Box 610, Sidney, Neb. An object of this invention is to provide a beet topper which is adapted to sever the tops of the beets while they are still in the ground. A further object is to provide cutting means adapted to sever the tops at the desired height, and to dispose of the cut tops at one side of the row of beets. A further object is to provide a cutting drum which is both simple and efficient.

CHURN.—D AYERS and H D FOSSETT, Mount Vernon, Mo. This invention relates to agitators especially adapted for use as butter churns, cream whipper and the like. An important object is to provide means whereby the agitators may be applied to receptacles of various heights, and having simple means whereby the same may be applied to receptacles of various widths.

ANIMAL POKE.—D AYERS and H. D FOSSETT, Mount Vernon, Mo. Among the objects of this invention is to provide an animal poke having means whereby it may be detachably secured to a halter or headstall of ordinary construction and thus adaptable for application successively to a plurality of animals, and may be adjusted for application to animals of different sizes. The device tends to restrain an animal from moving too near a fence or like object.

PORTABLE COMBINED COTTON PICKING, GINNING, CONDENSING AND COMPRESSING MACHINE.—MARY W. SILVERTHORNE, Martins, S C. The most important feature of this invention resides in the combining of cotton picking, ginning, condensing and compressing mechanism on a vehicle to render the machine portable and capable of being moved into a field as an entire unit so that the complete operations from the picking of the cotton to the bailing thereof may be finished on the field, with a minimum number of helpers, the cotton being transferred from one process to another by a continuous air current.

Of General Interest

WARDROBE TRUNK.—A. L. DUFF and J W MATHESON, 168 Sterling Place, Brooklyn, N Y The general object of this invention is to provide a trunk having means for hanging garments in the wardrobe section in a manner that the hung garments may be compact in the trunk or slid out and disposed in any one of various angular positions to be readily accessible, and having a section provided with drawers of various depths, the two sections forming a complete trunk.

CONCRETE BLOCK AND THE LIKE.—H. WILKINS, 71 Third Ave., Malville, Johannesburg, Transvaal, South Africa. The object of the invention is to provide means whereby blocks can be held together more rigidly than those at present in use, and to simplify and facilitate the construction of a building without the use of any agglomerate at the ends of the blocks which interlock owing to their shape. The invention is applicable to all forms of through cavity concrete blocks.

DISPLAY DEVICE.—L. GOODMAN and A. GOLDSTEIN, 86 W 119th St., New York, N Y The general object of the invention is to provide a means in conjunction with a container for supporting goods in display arrangement so that in order to disclose the goods all that is necessary is the opening of the container A further object is the provision of a display device provided with a plurality of supporting means for retaining the articles in spaced relation from one another so that they may be mounted for view in any desired position.

TABLE.—G E. TOMLINSON, Winchester, Ky This invention has for its object the provision of a collapsible table. Another object is the provision of means whereby the table top may be simply, quickly, and accurately connected and placed on the supporting leg portion and the bracing members securely locked in place so that the supporting legs are maintained in a rigid spaced relation.

AWNING.—C. B. NORVELL, 214 No Foushee St., Richmond, Va. Among the objects of the invention is to produce an awning where means is provided for positively preventing movement of the awning in the wrong direction, thereby precluding the possibility of the awning material being torn or otherwise injured. Another object is to provide a device which is simple and durable and comparatively inexpensive to manufacture.

CIGARETTE PACKAGE.—C E. ARNOLD, 724 "E" St., San Diego, Calif The invention has particular reference to an attachment for cigarette packages which is adapted to be associated with the package in such a manner that the individual user may rely on the same as a convenient means of obtaining access to the cigarettes within the package when the same is first opened.

PLAYING CARDS.—R. DE W HAAS, R. No. 1, Box 71, La Habra, Calif. The object of the invention is to provide playing cards by means of which various games may be played including practically all games to which the ordinary playing cards are adapted. While differing materially from the usual playing cards these cards are adapted to the playing of many games beyond those of which the ordinary playing cards are adapted.

SNOWPLOW.—E. LEVY, Munising, Mich. The invention relates to snow plows adapted to be drawn or pushed by a tractor. The general object is to provide a plow whereby a track will be plowed ahead of sleighs with which the apparatus is equipped. The plow is so arranged that a single operator can control the same with respect to raising or lowering the nose plow, as well as controlling either the front or back for steering.

GUIDE FOR USE IN SEWING.—MARY E. BURNETT, 210 W. Boulevard, Marion, Ill. This invention has particular reference to gages and guides and has for an object to provide a simple instrument by which the width of a hem may be readily gaged and indicated. Another object is to provide an indicator which may be frictionally held on a scale measure or bar to indicate in inches the width of the hem in ornamental stitching or like work.

PORTABLE HANDLE.—C. HAARBERG, Box 358, Fox Lake, Ill. This invention has for an object the provision of a handle which can be used to quickly and conveniently engage the wall of a box, crate or other container or article, so that the handle, when grasped by the operator is prevented from slipping, and may thus be utilized to lift or otherwise manipulate the article with which it is in engagement.

COMBINED BLOTTER AND PENWIPER.—G B. MULLEN and J H. MULLEN, Bell Ave., Bayside, L. I., N Y The principal object of the invention is the association of the elements in a convenient manner for the drying of the ink and the wiping of a pen, the penwiper constituting a convenient handle for picking up the blotter from a flat surface, such as the top of a desk. The article is simple and inexpensive to manufacture.

RETAINING RING FOR RECEPTACLE CLOSURES.—A VAN A. FELTEN, 38 Morris St., Danbury, Conn. The invention aims to provide a cover retaining ring adapted to be utilized in connection with a receptacle including a body portion and a separate head, and the ring is of such nature that when used in conjunction with a head it causes the formation of a light seal between the head and the body at all instances. The device is of such character that when once in applied position, it will not become accidentally displaced.

SHOE TREE.—A H KEYS, 1672 Eddy St., San Francisco, Calif. The primary object of the invention is to provide a simple and inexpensive device, in the form of a shoe tree or support, which may be easily manipulated and capable of keeping the shoe in good shape. The device is intended to be made of a light metal and may be conveniently handled.

SHOE EXPANDING APPLIANCE.—A. H. KEYS, 1672 Eddy St., San Francisco, Calif. This invention relates to an appliance for use by individuals for expanding shoes so that the same may be made to more comfortably fit the feet, particularly in cases where persons are with corns or bunions. The device may also be used to perform the functions of a shoe tree.

FILING DEVICE FOR SOUND REPRODUCING RECORDS.—C. U FINOCCHIARO, 1528 Amsterdam Ave., New York, N Y The invention has for its object to provide a filing device for sound reproducing records having two series of rods spaced apart, the rods being so spaced that records of different diameters may be conveniently accommodated The device is not only applicable to a cabinet adjoining a phonograph, but may also be made in the form of an individual record cabinet.

SANITARY COVER FOR MILK CANS.—J E. DACEY, 825 So. Brady St., Dubois, Pa. Among the objects of the invention is to provide a cover which may be conveniently constructed of a single piece of sheet metal and which may be readily associated with an ordinary condensed milk can and manipulated so as to occupy either closed or open position, permitting a supply of milk to be taken from the can, or when closed preventing flies or dust finding its way into the milk.

BURIAL APPARATUS.—H. H. LEAVITT, Wadesboro, N C. This invention relates to an apparatus for use in lowering a casket into the grave, an object is to provide an apparatus by which the casket may be taken to and lowered in the grave in a solemn manner in keeping with the ceremony without the necessity of the pallbearers approaching so close to the grave as to cause caving, and which also serves as a guard to prevent the mourners from approaching too close.

SELF-SERVICE STORE.—A. W. B. JENNINGS, 1916 First Ave., Birmingham, Ala. The object of the invention is to provide a self-service store with a plurality of

compartments with service stations at the entrance and between adjacent compartments, there being a passageway in one direction at one side of each service station and passages in the opposite direction at the other sides. With this construction customers may be watched in relatively small groups by the clerks who receive money in payment of sales and who wrap the goods.

WINDOW GUARD.—T. C. RUSH, Lexington, Ky. This invention has for an object the provision of a device capable of adjustment to suit various sized window frames. A further object is to provide the guard with a form of latching and locking means for effectively preventing its unauthorised removal. The device may be collapsed so as to occupy a comparatively small space when not in use.

RECEPTACLE CAP.—E. R. MARTIN, 329 Tea Neck Road, Ridgefield Park, N. J. The invention more particularly relates to a dispensary cap for a fluid within the receptacle. The invention has reference to a receptacle cap suitable for association with any desired type of container and by means of which an operator may introduce just that amount of fluid with which a receiving receptacle should be filled, thus not necessitating the use of a stopper for preventing an evaporation of the fluid.

MAIL CHUTE.—J. J. CUSICK, 78 La Salle St., New York, N. Y. The general object of this invention is to provide in association with the letter drop of each floor of an office building or apartment house an auxiliary choke chute which will retain any matter deposited therein which could possibly clog the main chute. A further object is to afford means for ready access to the auxiliary choke chute should that become clogged.

OUTLET VALVE FOR FLUSH TANKS.—T. J. CAHILL, 810 Carrizo St., Corpus Christi, Texas. The invention relates generally to outlet valves for flush tanks of toilet bowls. The main object is to provide a valve which is constructed in such a manner as to trap a volume of air, whereby upon the initial lifting of the valve the air trapped therein will operate to buoy the valve in the water until the emptying of the tank is effected.

SCAFFOLD.—F. A. SAMPSON, Forest Lake, Minn. The invention has for its object to provide mechanism for use in connection with the usual three-cornered scaffold brackets for firmly anchoring the brackets to the wall being constructed, wherein a suitable clamp is provided for engaging the studding, the bracket having means for engaging the clamp to support the bracket.

WATCH PROTECTOR.—M. M. GETO, c/o Watch Protector Corp., 334 E. 23d St., New York, N. Y. This invention has for its object the provision of a simple device whereby the improper removal of a watch from a person's pocket is made impossible without the owner of the watch being made aware of this attempt. A further object is to provide a device which appears merely to be a neat and artistic ornament in connection with the watch chain, yet acts to achieve the above-mentioned object.

SOLDERING BLOCK.—S. E. RANDALL, Box 884, Smackover, Ark. An object of the invention is to provide a simple device for holding a broken finger-ring in position to permit of the ends thereof being joined together by welding, brazing, or the like, without subjecting the stones set in the ring, or ornamental portions, to the action of the flame required for the operation. A further object is to provide a device which is adapted for use with rings of various sizes.

EXPLOSIVE CARTRIDGE.—S. DECKER, R. F. D. No. 2, Commodore, Pa. Among the objects of this invention is to provide an explosive cartridge having simple means whereby the same may be fired either by a fuse or by a needle which is engaged with one end of the cartridge so as to puncture the same. In carrying out this object the ends of the tubular body are filled with corn cob plugs, through which only a slight force is necessary to puncture the cartridge. The cartridges are so constructed that they may be conveniently carried into the mine and maintained in a dry state.

SAFETY RAZOR.—F. KULHAWY, 120 27th St., Guttenberg, N. J. The invention relates to safety razors of the double-edge blade type. One of the principal objects resides in the provision of blade supporting and blade clamping members, respectively, formed at the edge with guard teeth. Another object is the provision of a razor so constructed as to permit of the arrangement of the guard teeth to properly guard one edge of the blade so that it may be used for cutting hair, while the other edge is exposed for stropping.

METHOD OF PREPARING FRUIT AND VEGETABLES FOR SHIPMENT.—T. J. PETERS, Peters, Fla. This invention has for its objects the provision of a process and apparatus for treating fruits and vegetables prior to shipment to protect them from rot and other disease while in transit. Another object is to treat fruits and vegetables with a view of hastening or retarding their maturity according to the period of transportation. The process consists of immersing the fruit in a special device containing water at 125 degrees F. or 34 degrees F. for a period of from 15 to 90 seconds.

PENCIL.—J. R. FITTON, c/o C. E. Morse, 537 W. 7th St., Long Beach, Calif. An object of this invention is to provide a pencil having a tubular barrel or casing and a novel means for projecting and retracting a removable lead beyond the forward end of the casing. A further object is the provision of a device which is simple, convenient to operate, and not likely to easily get out of order.

PROJECTING SCREEN.—J. W. PECK, Jr., 900 Mansfield Road, Brooklyn, N. Y. This invention particularly relates to a screen for displaying motion pictures. The principal object is to provide a screen which includes a reflecting surface of frost or snow, said surface being formed by a refrigerating apparatus. The screen will produce an unusually fine reflecting power, and will at the same time serve to cool the house. Provision is made for keeping the surface free from dust and insuring a smooth surface at all times.

NURSING BOTTLE.—J. MAY, 2002 Hawthorne Ave., Portland, Ore. The invention relates to so-called hygeia nursing bottles and more particularly to fastening means for nipples therefor. For sanitary purposes this class of container is cylindrical in shape, and having no neck or head, the nipple employed is relatively large and will frequently leave the bottle and cause inconvenience. The purpose of the invention is to provide a fastening means for the nipples whereby every possibility of the same becoming detached from the bottle is eliminated. (See Fig. 1.)

PRESS.—A. C. VOWELL and W. O. VOWELL, 227 W. Capitol Ave., Little Rock, Ark. Among the objects of this invention is to provide a press which is adapted to be placed within a container for kraut, pickles, fruit, and the like to hold the solid contents below the surface of a liquid therein or to hold the contents in compact mass. The press is provided with means for engaging the wall of the container to releasably hold the press in various adjusted positions within the container. (See Fig. 2.)

Hardware and Tools

SHOVEL.—P. W. ELY, Jonesville, Va. The invention relates to a shovel especially adapted for removing the dust caused by cutting machines used in coal mines. The electric machines employed for forming a space beneath a quantity of coal to be blasted cause a large quantity of dust, which must be removed before the blasting operation takes place, otherwise the coal would settle on a cushion of dust and would not break up, or might cause a fire or coal dust explosion.

TRAP.—C. THERIOT, address W. M. Bowie, Atty., Houma, La. Among the objects of this invention is to provide a trap for catching muskrats or other fur bearing animals. The primary object is to provide a trap of this character which is adapted when trapped by an animal, to close about the body, and securely hold the animal, thus preventing the fur upon the leg from becoming damaged.

DUPLEX TOOL HOLDER.—I. ERICKSEN, 1807 N. California Ave., Chicago, Ill. An object of the invention is to provide a device adapted for attachment to the reciprocating ram of a shaper or planer and provided with means for operatively engaging work during both movements of the reciprocating ram. A further object is to provide a device adapted to hold cutting tools of various kinds, whereby a "roughing" cut and a "finishing" cut may be made alternately.

HACK SAW.—N. H. COWELL and E. NIEDERMAN, 618 West 135th St., New York, N. Y. The invention relates more particularly to a hacksaw frame. An object is to provide a construction whereby different sized hack saws may be readily utilized, and to provide adjusting means for gripping and holding hack saws which have been broken off either at one or both ends, wherein not only means are provided for engaging eyes in a hack saw, but for gripping the ends and holding the same in place.

LEVEL ATTACHMENT.—L. W. TIFFANY, Winsted, Conn. It is an object of this invention to provide a device which is intended to be associated with a level, and which may be applied to any level of standard type, whereby the distance between two planes extending in a single surface may be measured. The device is especially adapted for work requiring great exactitude.

PARING KNIFE.—F. SARGENT, North Lubec, Me. The general object of the invention is to provide a device which will facilitate the paring of fruit and vegetables in such manner that there will be no waste, or in other words a knife provided with means for preventing the same from cutting too deep into the article pared. The knife is particularly designed for paring vegetables or fruit having hollows therein. (See Fig. 3.)

CAN.—M. M. SHACKITT, 236 N. Jersey Ave., Brooklyn, N. Y. The invention relates to metallic shipping and storing vessels, its object is to provide a can more especially designed for household use for ashes, kitchen refuse, and the like and arranged to provide an exceedingly strong can capable of withstanding rough handling. Another object is to permit the user to readily place the ashes or refuse into the can without removing the cover and to prevent undesirable odors from escaping.

BOTTLE CAP REMOVER.—L. A. TYLER, 23 Wilson St., Salamanca, N. Y. This invention particularly relates to a device for removing the usual paste-board cap from milk bottles, an object being the provision of a device of this character which will be entirely sanitary, which will be simple and practical in construction and inexpensive to manufacture.

EXPANSIVE DRILL BIT.—J. P. MILLER, c/o Terrebonne Gas Co., Houma, La. One of the foremost objects of the invention is to provide a drill bit the blade of which expands when weight is imposed thereon. A further object is to provide a drill bit including a holder of collar formed with a socket provided with a slot and such an arrangement of bevels that the blades are caused to spread when slid up the slot, to drill a hole larger than the diameter of the casing in which the drill operates.

BAIL LOCK.—W. S. COLE, c/o Genl. Deliv., Johnstown, Fulton County, N. Y. The principal object of the invention is to provide means which will prevent swinging of a pail on the bail when it is being carried, and yet to provide means for permitting the bail to be swung to horizontal position when such swinging becomes desirable. A further object is to provide a bail locking device which may be applied to all forms of containers having bails associated therewith.

COMBINATION PLANE.—C. A. TRUMP, Box 37, R. F. D. No. 1, Derry, Pa. The invention relates to woodworking tools. An important object is to provide a tool which may be used as a rabbeting plane, a block plane, or a smoothing plane by a simple adjustment of the various parts. A further object is to provide a plane having simple means whereby the position of the handle may be readily changed to adapt the plane to various uses.

KNIFE.—E. LEWIS, 425 S. 16th St., Terre Haute, Ind. An object of this invention is to provide a knife of simple construction which is adapted to hold a plurality of blades in such manner as to permit of their easy removal for sharpening and replacement to operative position. A further object is to provide a knife which is adapted for use in marking, splitting and cutting composition roofing, beaver board, leather, felt or the like, and as a pruning knife for shrubbery and the like.

PIPE WRENCH.—E. J. EVANS and G. E. HEMPHILL, 313 Felt Bldg., Salt Lake City, Utah. This invention has for its object to provide means wherein the jaws of the wrench may be quickly set to engage pipes or other work of various sizes, and at the same time be brought into powerful gripping engagement with the work. Another object is to provide a wrench which is simple and durable and comparatively inexpensive to manufacture.

SAW.—C. L. ARNOLD and C. FOELEN, Bardstown, Ky. The invention relates to band saws especially adapted for use by butchers. An important object is to provide a band saw having means whereby the saw may be tensioned as the occasion requires, or disconnected for cleaning. A further object is to provide a saw having means whereby the several wheels which support the band saw may be simultaneously operated so that slipping is reduced to a minimum.

RIPSAW STICKER HEAD.—J. C. WILLIAMS, 1804 E. 55th St., Cleveland, Ohio. The invention relates to cutter heads carrying blades used in wood working. An object is to provide a cutter head which is adapted to be applied to any saw arbor of

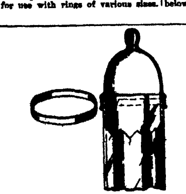


Fig. 1. This sanitary nursing bottle is the invention of J. May

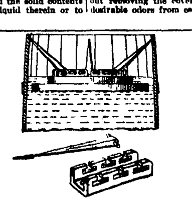


Fig. 2. This press for holding down kraut, pickles and fruit was invented by A. C. and W. O. Vowell

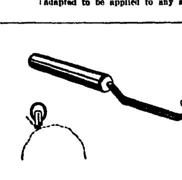


Fig. 3. Paring fruit on the safety razor principle is made possible by F. Sargent, the inventor of this knife

known construction, and holding cutters for use in producing mouldings of different con figurations and for finishing strips of mould ing to adapt them to be joined together by coped joints A further object is to provide a cutter head for firmly holding blades of different sizes.

LOCK—L FRIEDMAN, 9 Oak St., New York, N Y One of the primary objects of the invention is to provide a locking mechanism of such structure as to prevent a forcing open of a door by springing the same relative to the jamb commonly known as "jimmying" A further object is to provide a lock which will automatically snap to locking position upon closing the door and which includes a combined manual and key operated means for releasing the lock.

FISHING TOOL.—W CASEY c/o J B Bartlett Atty, Tulsa, Okla The object of this invention is the provision of a tool which is adapted for connecting itself with loose material or tools which may be in the bot tom of an oil well or other well of small cross-sectional area and thereby permit said loose material or tool to be lifted The tool is simple and inexpensive to manufacture.

LOCK—D F MORRIS and T T MORRIS What Cheer, Iowa Among the objects of the invention is to provide a lock for securing together the end links of a chain, which will serve as a link for connecting together the ends of a tractor chain, or the like and which will prevent the possibility of theft, will permit the chain to be quickly and easily detached by the rotation of a special key for engaging the latch and which is simple and durable in construction (See Fig 4)

Heating and Lighting

HYDRAULIC VALVE FOR WATER HEATERS—W E. KAY, 422 E Broad St., Elyria, Ohio The object of this invention is to provide increased practicability and efficiency, in action in a controlling valve by means of which water and gas are supplied to an instantaneous water heater or analogous device The device is also de signed with an object of overcoming the weakening or breaking of the valve operating parts

FRUIT SIZING MACHINE.—H B HATCH, c/o Skinner Machine Co, Dunedin Fla The invention particularly relates to that type of sizing machine which embodies a traveling carrier arranged to support the fruit and carry it along until the point of discharge for fruit of a particular size shall have been reached, at this point one of the elements which support the fruit shall have moved to such an extent with relation to an adjacent element, as to permit the release of the fruit and deposit it in that group to which it belongs.

SPINDLE PROTECTOR.—W P WATSON c/o Watson Silk Co, Phillipsburg, N J The general object of the invention is to provide an efficient means for protecting the threads on any spindle of a spinning machine from the threads on adjacent spindles should they break A further object is to provide a protecting means which allows the operator access to the spindles but still protects him to a certain extent from being hit by the flyer while working about the spindles.

DRAG LINE EXCAVATOR. — A P STEELE, Statesville, N C The invention has for an object to provide a drag line ex cavator for digging and loading clay or other earthy material and to so arrange the sheaves through which the cable supporting the bucket operates that the path of travel of the cable from the operating drum mech anism to the end of the boom shall have as few turns as possible, thus preventing wear and tear and effecting a saving of power

RECORDING DEVICE FOR LIQUID PUMPS—A B SNYDER, Grass Valley, Calif Among the objects of the invention is to provide a recording mechanism for use in connection with gasoline dispensing pumps, that will eliminate all chances of error, and compel the operator to cause the sale to be recorded. A further object is to provide a dial and a hand moving over the same that will indicate the quantity with drawn, and will automatically be returned to zero before a new quantity can be with drawn

OSCILLATING CYLINDER. — W R. HOTCHKISS 2331 University Ave., St. Paul, Minn The invention relates to paper straightening devices especially adapted for straightening sheets of paper upon being discharged from perforating machines, ruling, [illegible] or bronzing machines, printing presses or the like, the device providing a jogging movement for straightening the paper when being arranged in a pile so that it may be conveniently handled.

TUBING STABILIZER—E. V CROWELL, Box 1479 Station "C," Los Angeles, Calif The purpose of the invention is to provide a stabilizer for the pipe which con ducts the oil from the bottom of an oil well to the surface, and to eliminate the longitudinal stress, and the lateral vibration occasioned by the movement of the pumping valves within the tubing.

OIL BURNER.—G M. KERRIHARD, 401 W Coolbaugh St, Red Oak, Iowa An object of the invention is to provide an oil burner of simplified construction which is adapted for use in furnaces of various known types of construction in which coal has heretofore been used as a fuel, and without any extensive changes, if any, in the usual construction of the furnace being required. A further object is to provide a burner in which the heavier and cheaper, as well as the lighter grades of oil may be used

ROTARY KETTLE KILN FOR BURNING AND DRYING PLASTER STONE, PLASTER, AND OTHER SIMILAR SUBSTANCES — G JOURNET, Paris, France. This kiln comprises two cylindrical kettles on horizontal axes placed one above the other in one and the same furnace, each of which revolves slowly in a contrary direction from the other Interiorly the kettles are provided with helical wings for mixing the material and driving it towards the outlet situated in one end

OIL BURNER—J H SMITH, 92 Cypress St. Watertown, Mass. The aim of this invention is to provide an oil burner of a type which is capable of utilizing kerosene, and is also adapted for household pur poses. A further object is to provide a nozzle or burner proper, capable of being utilized in connection with any type of low grade volatile oil but particularly kerosene, and by reason of the construction the parts will not be damaged incident to the action of the heat.

IRON PURIFYING AND BALLING FURNACE.—O S. PULLIAM, 28th Floor, Singer Bldg, Broadway, New York, N Y The invention relates to metallurgical furnaces. It is an object to so construct such a furnace that the mechanism employed for bringing the oxidizing agent and the molten iron into intimate contact one with the other will be effective, and at the same time such mechanism is of a nature to properly manipulate the molten metal during the balling process.

Machines and Mechanical Devices

CUTTING APPARATUS.—A. W HOUCK, address Edmond Rushmore, c/o Spanish Am Fruit Co, Singer Bldg, Broadway, New York, N Y The invention aims to provide a cutting apparatus for use in the canning industry where spherical edible objects such as fruit and large vegetables, must be cut up into fifths, quarters, thirds or other subdivisions in order to obtain parts small enough to be properly packed in commercial sized cans or jars, and wherein the object is passed through the cutting machine which makes the subdivisions simultaneously

WATCH—J V ORR, Box 146, Monroe, Wash. An important object of the invention is to provide a watch having means whereby the second hand may be set at 60 so that when the hour and minute hands are set the second hand will be in exactly the right starting position The setting mechanism does not in any way interfere with the operation of the watch or place an excessive strain on the same.

GREASE CUP—C. C. HAMILTON and J HUTCHINSON, Box 80, Gull Lake, Saskatchewan, Canada. Among the objects of the invention is to provide a grease cup in which the body portion carries a spring member adapted to engage a detachable cap in such manner as to prevent retrograde movement of the cap relative to the body portion on account of vibration, and having means for guarding the inlet end of the discharge portion to prevent the passage of solids or semi-solids which would obstruct the feeding of the lubricant

SAWING MACHINE.—C F REICHSTEIN, Medford, Ore The invention particularly relates to a machine for sawing fire-wood. The purpose of the invention is to provide a machine which is adjustable to saw the sticks into twelve or sixteen inch lengths, although the machine may be adjusted to cut the sticks into blocks of any required stove length A further object is to provide a machine capable of being operated by a single individual

MECHANICAL COTTON PICKER.—R. G RYCROFT, Greenfield, Okla. The special object of the invention is to provide a machine adapted to gather the exposed lint or lock of cotton, leaving the boll and other parts of the plant, as well as foreign matter free, the cotton picker consisting of a suitable transporting means or vehicle having a frame adapted to straddle the growing cotton row, and having means for guiding the branches into position for the action of picking the cotton and discharging the same free from foreign substances.

BRUSH FOR TALKING MACHINES —J F and W BORST, 1115 Cypress Ave., Brooklyn, N Y The primary object is to provide a brush especially adapted for use in connection with talking machines in which the sound box is of universal type i e, adapted to play records of both hill and dale and lateral-cut types. A further object is to provide a brush capable of swinging movement in order that it may move to a position in the path of the stylus.

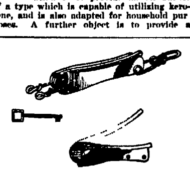


Fig 4. D. E. and T T Morris are the inventors of this combined chain link connection and lock

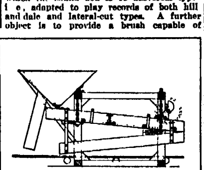


Fig 5. This gold-separating machine is the product of J Dee

AIR LIFT FOR AGITATORS FOR ORE AND OTHER MATERIALS.—G T GEBINGER, Rio Guinobatan, Masbaté, Philippine Islands. A specific object of the invention is to provide a device for aerating, agitating and transferring liquids or a mixture of liquids and solids from one container to another In this device, the power of transmission through the air line is effective The wear is slight, and regulations can be very simply effected. In addition there are no moving parts to watch and lubricate.

MILLING MACHINE.—C KUBOLD, c/o Kinda, 320 E. 27th St, New York, N Y An object of the invention is to provide a device comprising but few parts which can be attached to milling or similar machines whereby threads may be produced by a very simple adjustment of the parts without the necessity for changing the parts or changing gears to produce different threads or spirals as is the usual custom.

THREAD GUIDE FOR REWINDING MACHINES.—F. E. KAUFMAN, 573 Prescott Ave., Scranton, Pa. The invention relates to thread guides for rewinding machines and has for its object to provide a construction which may be used on old or new spindles. A further object is to provide a simple construction in the form of a removable knob for holding the thread guide structure in place which may be applied to spindles of different sizes and removed readily without injuring the spindles.

PACKER PLUG.—M. E. INSKEEP, Seal Beach, Cal. An important object of the invention is to provide a packing plug having means whereby the same may be anchored in an oil well casing after a quantity of cement has been forced into the casing to close the cavities adjacent the lower end of the same, whereby the oil is prevented from flowing upwardly between the wall of the well and the wall of the casing, the packing may be anchored a predetermined distance above the lower end of the well.

GRAIN AND SEED CLEANING MACHINE.—J HAUGHOM and A. N FOSS, R. No. 3, Fargo, N D The invention relates to a separator or cleaning machine for grain and seeds, the object being to provide a seed mill or separator adapted to thoroughly clean the seed of all straw or chaff or like particles. A further object is to so construct the riddle screens of perforated sheet metal, that the mesh or size of the openings may be varied according to the grain to be cleaned, thus adapting the device for cleaning flax, wheat, clover, and timothy or other seed or grain

CONVEYER.—G HAISS, c/o Haiss Mfg. Co., 141st St. and Rider Ave, New York, N Y Among the objects of the invention is to so construct a support or framework for endless conveyers that the side spillage of the conveyer belt is prevented from entering upon the inner surface of the lower flight to a position where it can be conveyed to the supporting rollers of the belt, and to provide a frame-lifting mechanism by means of which the angle of elevation may be varied within certain predetermined limits.

REFILL CARTRIDGE FOR LUBRICANT GUNS.—A. E. SIMMONS, 1216 8th St., Eureka, Cal. The principal feature of the invention resides in an arrangement whereby lubricants for grease guns may be conveniently vended in a package which is suitable for use in combination with the cylinder of the gun for conveniently effecting a transfer of the lubrication from the package to the gun cylinder

BORING MACHINE.—J A MACEY, 834 Scott Ave, Kansas City, Kan This invention is especially adapted for use in reboring cylinders of engines. An important object is to provide a portable machine having a plurality of radially arranged cutters adapted to uniformly engage the wall of the cylinder and which will not make a deeper cut than desired A further object is to provide a machine which may be readily attached to a cylinder and adjusted for operation

ROAD AND STREET CUTTER.—A. ZILBERSHER, 42 W 57th St., New York, N Y An object of the invention is to provide a cutter for asphalt roadways, wherein a structure is presented which will readily cut the roadbed when pressed by a roller or other weight, the arrangement being such that small sections may be cut, so that the surface may be readily removed, and the new asphalt placed therein

CONTROL APPARATUS.—T McLEOD 534 East Jersey St., Elizabeth, N J This invention is designed more particularly for embodiment in the control apparatus for steering gear and has in view to so manipulate the device that the restoring of the parts to the exact position desired will be insured • The object is accomplished through an arrangement insuring a balance of pressure in the chambers of the device so that the steering gear returns unfailingly to position after an operation

CAN SEALING MACHINE.—M. E. JOHNSTON and J O JOHNSTON, address James O Johnston, Troutmans, N C. An object of this invention is to provide a machine which will be relatively small and compact, and which will efficiently seal cans in a sanitary manner A further object is to provide a machine in which the can is stationary and clamped between a base plate and a seaming chuck having rotary head carrying seaming rolls operated in a manner to perform the sealing operation

COMBINED NAPPER AND SHEARING MACHINE.—M. PORTZSCH, 91 Overbrook Rd., Ridgewood, N J The invention has for an object to provide a construction wherein the handling of cloth is reduced to a minimum. Another object is to provide a combined napping and shearing machine wherein any desired number of nappers may be used with one or more shearing devices, so arranged that there will be a continuous operation of the cloth, and wherein the napping and shearing is done in a single operation.

GOLD SEPARATOR.—J DEE, c/o F McNutt, 17 Laidley St., San Francisco, Calif. This invention has for its particular object to provide a gold separating machine adapted to receive gold containing material and to treat the same while it passes through the machine in such manner that particles of gold are separated from other and lighter particles, and gathered in such manner that they can be withdrawn separately, for being subjected to further processes. (See Fig. 5.)

TOBACCO TREATING MACHINE.—H. GUTMAN, 941 So. Clarence Ave., Oak Park, Ill An object of this invention is to provide a process for mechanically treating tobacco leaves, whereby the necessity for removing the stems and midribs prior to their further use in manufacturing cigars, smoking tobacco, and the like, is obviated, thus effecting a considerable saving not only in the cost of manufacturing the article, but in time saved in the operation

AUTOMATIC OIL FEEDER FOR SILK-CONING MACHINE.—M MORRELL, c/o G W Carlucci, 1039 52d St., Brooklyn N Y The invention relates particularly to an oiling device for machines known as silk coning machines, and has for an object to provide a construction which will automatically oil the silk as it passes through the machine, and working in such a manner that an even quantity of oil is supplied to the silk thread throughout its entire length

FRUIT GRADER.—L. H BALWICK, 5464 Bond St., Oakland, Calif The particular object of the invention is to provide a continuous grader for fruit, of large capacity for a comparatively small size A further object is to provide a grader that will handle cut fruit, as for instance peaches or pears as effectively as whole fruit. A further object is to provide a grader that will not damage the fruit in any way during the grading operation, and may be adjusted for grading practically all kinds of fruit

COTTON MACHINERY.—J L HART, c/o Hart Cotton Machine Co, Chickasha, Okla. The invention relates more particularly to a saw adapted to be employed in the manufacture of cotton to separate the cotton from the other substances with which it is associated, such as hulls, seeds or foreign matter The object is to provide a device of this character of simple and durable construction, and comparatively inexpensive to manufacture

MOLDING MACHINE.—J F CALDWELL, 729 So. Bonnie Brae, Los Angeles, Calif This invention especially relates to molds adapted for use in the manufacture of gypsum blocks used for partition walls and other exterior work. The object is to provide a simple and reliable means whereby the blocks upon being formed may be removed from the mold without the possibility of breaking or adhering to the wall of the mold.

GATHERER.—A. E. PEARSON, Box 534, Littleton, N H An important object of the invention is to provide a sewing machine gatherer having means for gathering the finger of gloves and other pieces of work so that the same will be in proper position for sewing A further object is to provide a gatherer which may be readily and conveniently applied and which may be thrown to an inoperative position when not in use

ENGRAVING MACHINE.—B R CORLEY, c/o Turner Bros., 400 Pearl St., New York, N Y This invention relates to a machine using a needle for engraving letters, numerals and other characters on a coated plate, and includes a manually controlled transmitter carrying a stylus used for tracing the desired character on a master plate. An object is to provide means to enable the operator to accurately space the letters or characters irrespective of their width and shape, and to engrave the same in a straight line or an arch line. A further object is to permit of proportioning a character to be engraved to any desired width

COIN WRAPPING DEVICE.—L. E. PARKER, Wadsworth, Ohio The general object of this invention is to provide a simple and efficient device for wrapping coins which will allow the wrapping operation to be performed quickly and will produce a neat package. The object is accomplished by providing a device including means for rolling the wrapping means into a cylindrical form and supporting the same in conjunction with a coin guiding means.

SHUTTLE PRESSURE INDICATOR.—L. J MCCORMACK, Washington Ave, Dumont, N J Among the objects of the invention is the provision of a shuttle pressure indicator that may be mounted in a shuttle to record the strength of the strokes delivered by the picker sticks to provide means for guiding the operator in equalizing the strokes and in adjusting the machine so as to give the required stroke, thus greatly reducing the wear and tear on the machine.

OIL WELL DRILLING MACHINE.—H. C. BREWSTER, c/o Oil City Iron Works, Shreveport, La. An important object of this invention is to provide a drilling machine having simple means whereby one of the sections of the drill stem may be rotated with relation to the other sections. A further object is to provide a machine embodying inner and outer tables and means for holding the inner table against rotation so that the outer table which is operatively connected with the upper section of the stem may be turned with relation to the lower section which is held against rotation

PISTON AND PISTON RING.—I CISSKI, 5838 E. Green Lake Way, Seattle, Wash This invention has for its object to provide a single piston ring for a piston which is particularly efficient in preventing any gases from escaping from the combustion chamber and which at the same time will exercise a constant control over the oil admitted between the piston and the cylinder wall.

CHARGING DEVICE.—A J CLAUSEN, 1552 Lake St., San Francisco, Calif The invention relates to road paving machines and is designed as a convenient means for picking up a load of loose material such as gravel or sand, lifting it to a desired height, carrying it to the paver or mixing machine and dumping it into the same The object is to provide means which will allow trucks to dump the material at any convenient distance from the paver, from which the charger will pick it up and throw it into the paver when the machine is ready

Medical Devices

DOUCHE.—C E. SIMS, 508 W 9th St., Cisco Texas. The invention has for its object to provide a douche especially adapted for home treatment, wherein a pipe or nozzle is provided adapted to be interposed into the cavity to be treated, and having a base for closing the cavity, and in connection therewith a speculum for spreading the walls of the cavity to insure the thorough application of the medical preparation

Musical Devices

MUSICAL INSTRUMENT.—W BARTHOLOMAE, c/o Bar Zinc Toy Mfg Co, 83 Greene St, New York N Y The invention relates more particularly to instruments using tubes as the sounding members the arrangement being such that either a striking hammer may be used for producing the desired sound or substantially an ordinary key board with an action associated therewith The object being to provide an instrument which is simple, and with a minimum number of parts for securing the desired result

WOOD WIND INSTRUMENT.—R S FORREST, Rockford, Mich This invention has reference more particularly to a clarinet of the Boehm type in this particular type various tones can be produced in several ways which sometimes become confusing unless the player is very expert The object of the present invention is to simplify the manipulation of the pads.

FLUTE OR SIMILAR MUSICAL WIND INSTRUMENT.—W BARTHOLOMAE, 83 Greene St., New York N Y This invention relates to clarinets and flutes, its object is to provide a flute or similar wind instrument arranged to permit of securely attaching the mouthpiece to the tube in a very simple and inexpensive manner and without resorting to soldering as now generally practical Another object is to insure a firm close fit of the mouthpiece on the player's under lip

SOUND CLARIFIER.—C W JOHNSON 128 W 98th St New York, N Y The object is to provide a sound clarifier more especially designed for use in the amplifying chamber of a phonograph and arranged to eliminate dead air spaces and to insure a circulation of live air throughout the length of the amplifying chamber, to induce clarification of the sounds and to avoid muffling of the same

DEVICE FOR ADJUSTING VIOLIN BOWS.—C SAMPIETRO, 461 Barbey St., Brooklyn, N Y Among the objects of the invention is to provide means whereby a pupil or a user of a bow can simply and easily adjust the hairs to a definite tension regardless of the atmospheric conditions or other conditions which might tend to vary the tension of the hairs. The means of adjustment can be applied to any type of bow with a minimum amount of alteration

Prime Movers and Their Accessories

REDUCTION GEAR.—M. J WACLAW, 649 E. North St., Bethlehem, Pa. The invention particularly relates to the reduction of speed of steam turbines and free from the difficulties and objections necessarily incident to toothed gearing systems which ordinarily are used in connection with steam turbines for reducing speed. The stated object and others are attained by a flywheel and a set of magnetic rollers adapted to exert a reducing influence on the flywheel at the rim thereof.

VAPORIZER.—E. G BALLENGER, 805 Healey Bldg, Atlanta, Ga The invention aims to provide a vaporizer for internal combustion engines by means of which a uniformly efficient mixture will be produced at all times, which will serve to insure a minute subdivision and breaking up of the particles of the mixture, and by means of which the mixture will be heated in an extremely efficient manner so that a fluid embodying high explosive qualities will be produced

MOTOR METER.—W H MANNS, 6165 Norton Avenue, Cleveland Ohio The invention relates to means for indicating the condition of an internal combustion engine which can be quickly and readily attached to the cooling apparatus of the engine An object is to provide a device particularly adapted to be attached to the radiator for a liquid-cooled internal combustion engine to instantly indicate changes in the temperature of the cooling fluid.

ROTARY VALVE FOR INTERNAL COMBUSTION ENGINES.—A E. OLSON R. No 4, Browerville, Minn An object of this invention is to provide a rotary valve construction and controlling mechanism therefor, whereby the period of exhaust and intake of an engine may be accurately controlled It is also an object of the invention to provide a construction, whereby the time at which the exhaust and intake of an engine occurs may be accurately controlled, and to provide a construction which may be operated from a remote point

ENGINE CYLINDER AND HEAD.—D O BARRETT, P O Box 350, Springfield Ohio The invention relates to internal combustion engines, and has for an object the provision of a construction whereby the cylinder may be removably connected to a bed in such a manner as to be quickly removed or replaced A further object is to provide an overlapping structure for the cylinder bed and an overlapping structure for the cylinder and head whereby the packing gaskets are prevented from blowing out.

INTERNAL COMBUSTION VALVE.—V W PAGE, Melrose Ave Stamford Conn Among the objects is to provide a valve mechanism of the overhead type especially adapted for use in connection with air cooled motors, and to provide an adjustable mechanism by means of which the throw of the valve may be varied, and to so construct the mechanism that the valve stem may be properly cooled during the operation of the motor

SUCTION MUFFLER.—A. I CHARLTON Lowden, Iowa An object of this invention is to provide a suction muffler for internal combustion engines that can be easily made from the types of mufflers already on the market, preferably the Ford type A further object is to provide a suction muffler having a plurality of mechanically rotated propeller blades, which when revolved, create a vacuum in the exhaust pipe, thus obviating back pressure

TIMER.—L J BAIN, 42 W 39th St., New York, N Y The invention relates to timers for internal combustion engines which is simple strong and which will have positive operation continuously An object is to provide a timer for Ford automobiles in which a sliding contact is arranged between the contact post and the rotor whereby an even wear is produced on all the parts and whereby there will be no jumping of the contact brush and adjacent the contact section of the rotor

VALVELESS TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE.—F H. HENRIOD and P HENRIOD, Yverdon Canton of Vaud, Switzerland The two cycle engine of these patentees is distinguished by characteristic features embodied in an engine having cylinders each composed of a motor cylinder body and a cylinder body in which the preliminary compression of the explosive mixture takes place before being passed to the cylinder body of the other motor cylinder The passages through which the explosive mixture passes are so formed that the travel of the mixture from one cylinder to another is reduced to the minimum to promote efficiency in the operations.

Railways and Their Accessories

METAL TIE.—W L. VARNER, 412 Elder Avenue, Pratt City, Ala. An object of this invention is to provide a simple and effective means for supporting a pair of rails in parallel relation and for securely holding the rails to gauge and against spreading A further object is to provide a device which permits of longitudinal movement of the rails if required without allowing lateral movement.

AUXILIARY TRAIN CONTROLLING MEANS.—F J MCAVOY, 5 Walcott Terrace Newark, N J The invention relates to air brakes, its object is to provide an auxiliary controlling means for passenger and freight trains and arranged to enable the engineer to quickly and accurately control the train, throughout the several cars and practically at the same time and with uniform force The device may be installed on trains now equipped with New York, Westinghouse, or other types of brake systems.

GRAVITY CAR CONTROL.—R. C LYTTLE, 6243 So Keating Ave, Chicago, Ill An object of the invention is to provide a gravity-car control which is adapted to automatically slow up a car, such as a freight car, as the latter passes thereover, the braking force applied to the car being proportional to the weight of the car, and the force being applied simultaneously to all the wheels which pass thereover

RAILWAY RAIL FASTENER.—A. D PRESTON, 25 Walter St. Claremont, West Australia, Australia Among the objects of this invention is to provide a tie plate clamp and spike which cooperate to securely fasten a rail in place, and to brace the rail against lateral and vertical strains. A further object is to provide a fastener which will prevent the timbers from being cut into, or in other words will cause the tie to be evenly compressed under the weight of train loads.

RAIL FASTENING MEANS.—S B KILL, c/o Warner 1050 Bergen St Brooklyn N Y The invention relates to means for fastening railroad rails to ties one of the objects is to provide means whereby spikes used in connection with railroad rails are more effectively fastened down another object is to provide means whereby the rail and the spikes can be assembled in place and fastened in their assembled position with a great saving of time and labor

CAR BRAKE.—F C MCKNIGHT and A MCKNIGHT, 18 So 8th St Sharpsville Pa. Among the objects of the invention is to provide means operated by hand or power for releasing and reversing the brake shaft of existing brake mechanism in either direction, and to provide in such mechanism undercut teeth or dog clutches on a member fixed to the brake shaft to mesh with similar teeth on a sleeve movable on the brake shaft which has a foldable operating lever or handle

CAR UNLOADER.—I O TALIAFERRO, 105 Island Ave Ext McKees Rocks Pa The foremost object of the invention is to provide an unloader for removing such material as coal, sand, crushed stone and the like, from a railroad car or other vehicle, and to either discharge the unloaded material at a fixed point or at various points A further object is to provide mechanism which operates slowly down the length of the car, and removes such material in a swath of a width equal to that of a standard car

COUPLING FOR RAILWAY CARS.—M K CARR 638 2d St., Bremerton, Wash This invention has for its object to provide a device which is of simple and durable construction yet reliable in operation, and which is adapted to effect the automatic and efficient coupling of the cars or other vehicles, and which may be released without necessity of the operator going between the cars or vehicles.

GRAIN CAR DOOR.—I L. DRAKE, Blue Rapids Kan Among the general objects of the invention is to provide an auxiliary grain-car door to be employed beneath any approved main door the auxiliary door being adapted to be detachably secured at its ends to the sides of the door frame and provided with an opening controlled by a closure so that the auxiliary door while in position will permit the flow of grain and be bodily removable when sufficient of the material has run from the car

Pertaining to Recreation

GAME.—H I CORY 315 Jackson Ave., Jersey City N J The invention relates to a game apparatus wherein a large or small number of players may entertain themselves The apparatus comprises a casing and a rotatable disk, the disk having a plurality of apertures therein said apertures being arranged in circular and radial groups, the circular groups representing va-

rious suits in accordance with a card game, the apertures in any radial group having the same numerical value

WHEELED TOY.—B. Nefedon 715 Hopkinson Ave, Brooklyn, N Y This invention relates to a toy airplane mounted upon wheels and provided with a sail so that the toy will be blown over the ground. A further object is to provide a toy formed in several interfitting sections which may be disassembled permitting the top to be packed in a relatively small space.

GAME APPARATUS.—C F Doerr 260 W Broadway New York, N Y The invention aims to produce a single gameboard and set of playing pieces with which a plurality of strips may be associated in which said strips bear indicating indicia simulating various well known games such as baseball, golf tennis and the like, the device may be readily changed for the playing of the various games

TOY WAGON.—W H Lasear, 403 Craigie Hall, Cambridge, Mass. The object of the invention is to provide a carriage the axle of which will impart a rocking motion to its body A further object is to accomplish this rocking motion without alternatingly increasing and decreasing the power necessary to move the carriage by the introduction of a balancing weight, the result being a constant, even pull or push.

GAME APPARATUS.—K O Stromer, 465 H St, San Bernardino, Calif An object of this invention is to provide a game apparatus consisting of blocks or rectangular game pieces having numerals thereon arranged in such manner that a game or games may be played which exercises the mental faculties in problems of arithmetic and which constitutes a game of skill as well as of chance The game may be played by children or adults and lends itself to a wide variety play to exercise the player's ingenuity

TOY.—E. F Fox, Williamsport, Md This invention relates to toys of the automatic or self propelled type An object is to provide a miniature or toy airplane having means to cause the same to take flight and move about in the air in a manner closely simulating the movements of a full-sized plane of the conventional construction

Pertaining to Vehicles

SPRING WHEEL FOR VEHICLES.—H I M Peny, 6 Rue de Milan Paris, France The invention more particularly relates to a spring or elastic wheel for motor cars, and is characterised by a combination of rubber members which cooperate simultaneously to the wheel an elasticity which can be compared with the one obtained by the use of pneumatic tires, without the disadvantages of the latter

SHOCK ABSORBER.—L M Neal, 949 First St., Louisville, Ky The invention relates generally to shock absorbers and more particularly to the type adaptable to transversely disposed body springs and therefore especially applicable to Ford automobiles, the object being to provide a simple and durable arrangement which will promote a sightly appearance and may be quickly installed by a simple addition to the spring parts already in use

FENDER.—F Bush, Pressmen's Home, Tenn. An object of the invention is to provide a fender which is normally concealed within the bumper bar of an automobile, and which may be quickly moved to operative position to prevent injury to pedestrians or live stock which may inadvertently get in the path of the machine A further object is to provide a spring operated device, and pedal controlled means for operating the same from the driver's seat.

RIM MOUNTING.—W W. Vossburgh, 93 Fourth St., Troy, N Y. The invention provides a rim mounting which shall primarily permit of the association of a rim with a felly of a wheel in such a manner that all play as well as uneven strain upon the parts will be avoided. A further object is the provision of a device by means of which a single manipulation of the parts will serve to achieve the result, so that it will not be necessary to handle numerous parts, resulting in the soiling of hands and clothes.

SEAT SUPPORT.—F A Schnupp, Mechanicsburg Pa The purpose of this invention is to provide a simple and efficient means for removably supporting the rear seat in the body of a motor vehicle in such a manner that the seat may be easily positioned, or removed in an expeditious manner, for converting the automobile body into a van or truck.

SHOCK ABSORBER.—B Kerr, 871 Cromwell St, Sarnia, Ontario, Canada This invention relates to shock absorbers or fluid cushions, adapted primarily for use in connection with automobiles or other vehicles, in order to reduce the play between the body and running gear, especially the rear axle and housing of an automobile, whereby to allow the springs to be compressed with a very small amount of resistance and to absorb shocks due to recoil action in passing over uneven road surfaces.

OPERATING DEVICE FOR TIRE VALVES.—H M Howell, Monroe, La. The object of the invention is to provide an operating device for tire valves which may be conveniently and quickly associated with the barrel of the valve and which when so associated automatically engages, depresses and maintains depressed the stem of the valve proper thereby unseating the valve and permitting the air to escape, without requiring further attention, thus permitting deflation of the tube and packing by one person

SHOCK ABSORBER.—R. M Gruss, Cadillac Hotel, San Francisco, Calif Among the objects of the invention is to provide a shock absorber adapted to be applied to motor vehicles or the like for use in combination with the spring suspension thereof, for absorbing and equalising shocks incident to travel of the vehicle over rough roads, and to make the vehicle ride easier

MOTOR VEHICLE CONTROLLING SWITCH.—H Gottesman, c/o Munn, Anderson & Munn, Woolworth Bldg., New York N Y The invention relates to locks and alarms for motor vehicles, and more particularly to a device adapted for use in the ignition circuit. Among the objects is to provide a lock of the permutation type, which serves to control the operation of a switch A further object is to provide an alarm in combination with an electric switch in such a manner that upon an attempt by an unauthorised person to operate the switch the alarm will be sounded.

COMBINED WHEELED AND ENDLESS TRACK VEHICLE.—E. Rimailho, 12 Rue de la Rochefoucault, Paris, France An object of the invention is to provide a construction of apparatus in an automobile or other vehicle having wheels and endless tracks and capable of drawing directly or carrying a load over any kind of ground, whereby either of the two methods of progression may be brought into use at will, the one being suitable for roads, the other for various kinds of ground to be traversed.

ILLUMINATING ATTACHMENT FOR AUTOMOBILES.—A. H Sell, 858 So. 13th St, Newark, N J The invention particularly relates to an attachment embodying a reflector for throwing the light to the object or area to be illuminated, such as the meter or ornament mounted on a radiator, or to illuminate the license tag by reflecting light from one of the lamps on the automobile, for example, one of the headlights.

DEMOUNTABLE RIM.—J. T Landes and R. E. Landis, Bureau of Military and Civic Achievement, Washington, D C. An object of the invention is to provide a demountable rim of two sections, each section having its tire bead retainer or flange integral therewith. Another object is to provide a separable demountable rim, the point of separation of which is longitudinally or circumferentially of the rim base, with either base portion of the tire resting on its corresponding portion of the rim, the rim is so constructed that it may be readily withdrawn from tires.

WINDSHIELD FOR MOTOR VEHICLES.—E. A. Howard, 2321 Decatur Place N W., Washington, D C. Among the objects of this invention is to provide an auxiliary wind shield adapted to be associated with the ordinary wind shield sections of a motor vehicle, and to serve as a combined ventilator and storm shield. The auxiliary shield may be easily manipulated and moved to a position so that it will not interfere with the normal disposal of the wind shield sections of the vehicle.

CLAMP LUG FOR TIRE RIMS.—S. B. Collier, Orlando, Calif. One of the foremost objects of the invention is to provide a clamp lug for holding the clamping ring of a tire rim in place. Another object is to provide a clamp lug which may be swung out of the ring-engaging position without removing it from the bolt, the lug having a wedge and an eccentric both tending to tighten the clamping ring with each forward or backward impulse of the wheel

ROAD MAP HOLDER.—J C. Prewitt, c/o Southern Pacific Milling Co., Santa Margarita, Calif. The invention relates to holders for road maps adapted to be supported in plain view so that the driver of the vehicle may be able to study the map while driving the car The map may be supported in any convenient place in front of the driver, and the holder is arranged in such manner that it may be secured to the dash board, and the map easily slipped in and out. The inventor has been granted two patents of a similar nature.

SPOTLIGHT AND MOUNT THEREFOR.—F B Roberts, Freeman, Mo. The primary object of the invention is to provide means for supporting a spotlight, on a vehicle such as an automobile, in such a manner as to render the same adjustable in both a vertical and horizontal plane. A further object is to so construct the device that the movement of adjusting the light will be retarded for the purpose of preventing injury to the electrical connections.

VEHICLE.—F Hirschmann, 11 E. 106th St., New York, N Y The object of the invention is to provide a pedal operable vehicle adapted for use by children, the vehicle being attractive in form, easy to operate and calculated for affording amusement and a means for healthy outdoor exercise The vehicle body is in the form of an animal, or preferably a duck having a bill, and is provided with a sounding device simulating the sound of the animal

DIFFERENTIAL STEERING MECHANISM FOR TRACTORS.—O C. Hansen, Orosi, Calif This invention relates particularly to a steering mechanism adapted to be applied to the existing parts of a tractor without departing from the original tractor construction and intended to function as a secondary steering mechanism or in conjunction with the existing mechanism to enable turns and other maneuvers to be made in restricted areas.

TIRE-CHAIN HOOK AND TIGHTENER.—R. J. Kleinsick, Oxford Junction, Iowa. The invention relates to a device for tightening tire chains and other chains, its general object is to provide a device for the indicated purpose whereby effective leverage can be exerted for drawing the chain tightly and whereby the parts will be automatically latched after the tightening movement.

SIGNALING DEVICE.—F. A. Goodhue, 48 Cross St., Winchester, Mass. The invention has for its object the provision of means whereby the signal hand may be promptly returned to its inoperative position within a casing upon being released. A further object is to provide means whereby the spring which returns the signal hand to its inoperative position is at all times enclosed and thereby protected from the elements. A further object is to provide an electric light in connection with the signal which is also controlled by the signaling mechanism.

HEADLIGHT SHIELD.—J H. Pitschman, 177 Goethe St., San Francisco, Calif. The primary object of the invention is to produce a simple and practical device which may be conveniently installed within conventional headlights in such a manner as to cut out all possible glare annoyance, without sacrificing any of the light rays so far as concerns an adequate illumination of the highway within an area sufficient for all driving requirements.

WHEEL.—J H. Lockett, 408 Raymond Apartment, 1461 Alice St., Oakland, Cal. The principal object of the invention is to introduce shock absorbing or cushioning means between the rim and the hub of a wheel in such a manner as to be covered by the supporting structure. A further object is to provide a plurality of cushioning members cooperating with each other in such manner that each of them will support the load independently, and in case of damage allows of the removal and replacing of one cushioning member while the full load rests on the wheels.

HEADLIGHT.—R. L. Rice, Sr., and W M. Jordan, Jr., Hovey, Miss. This invention relates to headlights for automobiles or similar vehicles, and has for its object to provide means wherein the headlights are controlled by the steering mechanism in such manner that they turn with the steering wheels of the vehicle whereby the road is illuminated even on the sharpest turns. Further objects are to provide means by which the lights may be controlled to remain stationary, or may be removed and used as a spot-light enabling the driver to readily carry out repairs. (See Fig. 6.)

INNER TUBE FOR PNEUMATIC TIRES.—R. Nall, 668 38th St., Oakland, Calif. The invention relates in general to pneumatic tires as used on vehicles or automobiles. The primary object of the invention is to overcome the many disadvantages of the customary inner tube by providing a tube which will be unusually rugged and capable of withstanding abuses, and at the same time require only a moderate air pressure to supply the desired supporting medium. (See Fig. 7)

ANTIGLARE SHIELD FOR HEADLIGHTS.—H. E. Lux, 149 Southern Parkway, Rochester, N Y This invention has for an object to provide a side illumination for automobiles by utilizing rays from the headlights without the necessity of providing special lights at each side of the car. A further object is to provide an attachment for headlights, which incidentally constitutes an antiglare shield, and is adapted to be secured in front of the glass of the head light. (See Fig. 8.)

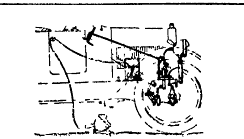


Fig. 6. This headlight, the invention of R. L. Rice, Sr., and W M. Jordan, Jr., automatically follows the bends in road

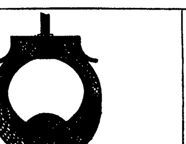


Fig. 7 R. Nall is the inventor of this ingenious inner tube

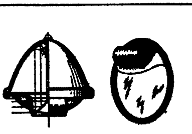


Fig. 8. To combine sidelights and headlight and cut out glare, H. E. Lux has invented this device

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Suggestion in Automobile Design

To the Editor of the SCIENTIFIC AMERICAN

There is a point in the construction of most makes of automobiles which may be the source of many accidents. This point is the front tip of the front spring hanger

As this front tip is now usually constructed, when, as occasionally occurs, the top spring leaf breaks close to the tip, the under leaves slide forward an inch or two throwing the car body out of balance on the chassis and also tightly jamming the steering gear Then the car of course leaves the road, to be more or less smashed, according to the rate of speed and the condition of the roadside.

The broken spring tip, when noticed, is charged up to the effect of the crash instead of its cause, and the newspapers call it a mystery that the driver lost control of the car

The front spring tips get a great deal of strain, where there is only the thickness of the top leaf and are apt to break sometime. The writer had this happen when he was going slowly enough to stop within thirty feet after leaving the road so that he was not wrecked.

Should not these front hanger tips overhang so that the lower leaves would not thus slide forward and jam the steering gear?

F P GRISWOLD.

Meriden, Conn.

Resuscitation: Fact vs. Propaganda

To the Editor of the SCIENTIFIC AMERICAN

May we have space in which to comment upon the article appearing in one of your issues some time ago, "Making Use of Gas in the Home Safe"? We assume your correspondent, in preparing this article, abstracted a leading article in the current issue of the "American Gas Association Monthly," by Dr Henderson, to whom reference is made

As to Dr Henderson's report itself, we are taking such steps as we feel proper to assure a continuation of the successful use of the pulmotor—the same resuscitation apparatus, as you will recall, which was highly honored by your organization in 1913 in the award to it of the SCIENTIFIC AMERICAN Gold Medal for the most successful resuscitation apparatus developed in three years.

As regards your correspondent's abstraction of Dr Henderson's report, there are two statements which are distinctly contrary to fact and for which even no authority can be shown in Dr Henderson's report. It should also be noted that these statements are decidedly discreditable to the pulmotor and contrary to the ideas of the officials of the Consolidated Gas Company of New York, who are still depending upon their pulmotors for resuscitation work

The quotations referred to follow

"An investigation has shown that the usual method of using a pulmotor is far from being satisfactory In some cases actual injury is done by inexperienced handling of the apparatus and the results, at best, are uncertain"

"The use of this apparatus has proved so great an advance over other methods that a number of rescue squads maintained by the gas company are now working in New York City with remarkable success."

Regarding the first of these statements the Consolidated Gas Company of New York have had pulmotors in uninterrupted service since 1912 The pulmotors are still being used. We are in receipt of supply orders on an average of more than one order every two weeks for maintenance of pulmotors for the Consolidated Gas Company, indicating that they are given considerable use

As an indication of the service being rendered by the pulmotors of the gas company of this city, permit us to quote as follows from the August number of the "Mutual Aid Bulletin," which we understand is published by the Consolidated Gas Company

"On Thursday, July 6, 1922, at 11.29 A M, the Consolidated Gas Company's emergency despatcher received a report from the police department to send all available pulmotors to a fire which had occurred in a train on the lower level of the Lexington Avenue Subway at Fifty-ninth Street.

"Four pulmotors were immediately sent to the scene and upon our arrival found a score of men and women partially asphyxiated from poisonous gases other than illuminating gas.

"Messrs. DeVorack, Wheeler, Hahn and Duane of the Twenty-first Street and Sixty-sixth Street emergency stations, rendered very heroic work in reviving a number of the victims, and were very highly praised by Dr H M Archer, chief surgeon of the fire department with whom they worked in conjunction

"In a statement signed by Dr Archer he stated that 'It was the Consolidated Gas Company's pulmotors which probably saved the lives of several'

"In the case of Harry Yonojsky of 112 East 103rd Street, one of the victims, the crew worked on him for 40 minutes, Dr. Archer stating on the company's pulmotor authorization blank, 'pulmotor saved this man's life. He was very near death and we called a priest. Sent to the Reception Hospital after we had restored him to consciousness.'"

Please note that the date of this incident was July 6, a time when Dr Henderson's inhalators were available for use through the Consolidated Gas Company Had that organization thought so highly of these inhalators as would be indicated by your article would it not be reasonable to suppose that they would have been put into service on this occasion instead of the pulmotors?

May we also briefly summarize from an article appearing in the house organ of the Consolidated Gas Company known as "Gas Logic' issue of April, 1922, as follows

"This year marks the tenth anniversary of the Consolidated Gas Company's introduction of the pulmotor for practical use in this city Its adoption considerably later by private institutions and by several of the city departments has made it so familiar as a means for the resuscitation of persons who have been overcome by poisonous fumes of all kinds and in cases of 'near drownings' that the casual use of a pulmotor and its frequent mention in the news columns of newspapers elicits little, if any, attention * * *

"These requests for the use of the Gas Company's pulmotors are not by any means confined to cases of persons overcome by artificial or illuminating gas. In many instances the pulmotors are used for the resuscitation of adults or children who through accident have narrowly escaped drowning In many other cases persons have been overcome by smoke or the fumes of chemicals that have been formed or liberated by fire A man and his wife, both *past 75 years of age,* were both revived after pulmotors had been used about an hour upon them The entire number of calls for pulmotors since November 1 1912, was 2801 not used in 1253 cases, successfully used in 1112, unsuccessfully used in 436 instances."

With the above facts before you, is there any possible way of justifying the statement that the usual method of using the pulmotor is far from being satisfactory?

Incidentally, may we call to your attention that "Pulmotor' is a registered trade name protected by U S copyright, and the initial letter should always, therefore, be capitalized This is not to be construed as a criticism of your correspondent, however as Dr Henderson made such improper use of the word in his report.

As to the statement that In some cases actual injury is done by inexperienced handling of the apparatus," you will surely appreciate that such a defamatory assertion regarding any apparatus and particularly as applying to a life-saving device with such a remarkable record and reputation as the pulmotor cannot and must not be made unless unquestioned proof is submitted No such proof has been given in the report, nor has it ever been given nor can it be given since no case is on record which can give the slightest indication of harmful results from pulmotor operation

In regard to the last of the objectionable *statements* viz. "The use of this apparatus (Dr Henderson's specially invented inhalator, known commercially as the H H Inhalator) has *proved so great an advance over other* methods that a number of rescue squads maintained by the gas company are now working in New York City with remarkable success", this statement is entirely contrary to the facts.

The H H Inhalators so highly recommended by Dr Henderson were installed for test purposes only by courtesy of the Consolidated Gas Company The Gas Company has never owned any of them They have not been used by the Gas Company in any case of respiratory failure but only after spontaneous breathing had been established by the pulmotor which always accompanied the H H Inhalator on such emergency wagons as carried the inhalator Officials of the Gas Company have informed us definitely that the H H Inhalators are not now in use and that the pulmotors are used exclusively as they have been for ten years.

Many experienced physicians who have devoted a great deal of their time to industrial work have taken issue with Dr Henderson, who is openly commercializing his patented inhalator, in respect to the advisability of using carbon dioxide at all in resuscitation work.

In this connection, I beg to quote *as follows from a* recent report issued by the Carnegie Steel Company In making reference to Dr Henderson's recommendations to use a small percentage *of carbon dioxide with oxygen for* inhalation purposes, the report reads

"However, it must be remembered that these experi*ments were performed on cases* where the saturation of the blood with the CO_2 was not over 40 or 50 per cent, and while there is no doubt about the CO_2 increasing the depth and number of respirations, yet it must also be remembered that in severe cases of gassing the percentage of saturation is much greater and that the heart is greatly weakened, so that with this sudden excessive stimulus it may fail I would not, therefore, recommend this form of treatment *except in expert hands, nor do I believe that in its present* state of development it should be used in severe cases of gassing

During the last few years, quite a *controversy* has arisen over the relative merits of the manual and mechanical means of artificial respiration, but both have their advantages and disadvantages. I prefer the mechanical method, using the pulmotor In over 100 very severe cases, this apparatus was used and excellent results obtained, with no noticeable after effects."

In view of the facts presented above, which may be confirmed in any manner desired by you—although, of course, not through Dr Henderson since the doctor has amply shown that he is not a disinterested party on the subject of resuscitation—we feel very strongly that a statement should be made in the next issue of the SCIENTIFIC AMERICAN pointing out that the pulmotor is being used successfully, that the statement that actual injury is caused in some cases by its use is not borne out by experience and that the Consolidated Gas Company of New York is continuing to use the pulmotor exclusively with the very best of success. We do not request this so much because we are manufacturers of the pulmotor, but more especially because it is of vital importance that the remarkable life saving now conducted by the local gas company and *hundreds of others* with their *pulmotors should* be extended everywhere possible for the conservation of human life in general Realizing as we do that your editorial staff desires entire accuracy in its columns, we feel confident you will make suitable adjustments in this matter

AMERICAN ATMOS CORPORATION

New York. F F MORRIS.

Container Cars Fifty Years Ago

To the Editor of the SCIENTIFIC AMERICAN

In a recent number your description of the Container System of transportation from London to Belfast, brings to mind that the same system was in use half a century ago on the Fall River Line, for carrying fast express between New York and Boston Your illustration shows four containers stayed fore and aft on a flat car the Fall River Line had a car arranged to carry containers its full length One morning the "steam boat train' tried to pass a freight train standing on the main line at Randolph, with the usual results the containers were broken open and the contents scattered over the landscape

C H. PEABODY

University Club, Washington, D C

Solving the Water Supply Problem at Panama

To the Editor of the SCIENTIFIC AMERICAN

Pumping fresh water 770 cubic feet per second 85 feet high at 71.25 per cent efficiency of plant will require 10 000 indicated engine horsepower An engine condensing will use indicating auxiliaries, not more than one half as much boiler horsepower as the engine indicated or 5000 boiler horsepower Compare such a *plant* with any of the great power plants of New York and other large cities and it will be seen that the power required is comparatively *small The cheapest fuel would no doubt be coal* which could be shipped from the Alaska coal fields, or from other sources of supply on both the South American and the North American continents. The amount of coal required per year with such a power plant running continuously, evaporating 10 pounds of water per pound of coal at 212 degrees Fahrenheit, would be 75,555 short tons. Assume that coal delivered to the canal by water will cost $5 per ton, then the annual coal cost would be $377,775

A pumping plant for this purpose, using direct connected steam pumping units, should not cost more than $100 per indicated horsepower or $1 000 000 total investment

To sum the whole problem up the annual cost for pumping all the water used as for the year 1920 would be

Fuel	$377 775
Ten per cent interest and depreciation	100 000
Operation	122.225
	$600 000

But the total water for power and lockage required in 1920 must have been nearly 2500 cubic feet per second *and if the shipping should increase to the equivalent of* the Sault Ste Marie Canal it might be 9000 cubic feet per second If the Chagres River furnished 2500 cubic feet per *second* in 1920 it may be assumed it will *do* it again This would have 3500 cubic feet per second for which power would be required, or $\frac{3500}{770} = 4.5$ times the amount as calculated for the locking in 1920 or $2 700 000 per year The revenue from the canal for one year is now about $11 000,000 this would be increased to 4.5 times or $49,500 000 at the cost for pumping would be approximately 5½ per cent of the revenue

PANAMAN.

manifestation that was about to occur. Mr. Lescarboura reports that this synchronism was perfect.

In the meantime, my button was shining forth unwatched. I was too busy to pay it much attention. The line of sight for these buttons was carefully placed sufficiently far in front of the medium to make it certain that he could not see them if he stayed in his chair. We figured that if he found the lights we should know that he had been up and moving about. At 9 18, just 53 minutes after we sat down, he did find them. That is to say, at this moment he asked about them, eclipses had been fast and furious for some time, suggesting that he had discovered them earlier and been trying to make out what they were. He asked whether they were psychic lights, giving us a lovely mental picture of a fake seance, at which one of the spectators might produce what the "medium" would take for genuine phenomena, to his everlasting and terrified bewilderment.

We were ready for the question. We explained that the lights were range lights to locate the far wall; at the Monday seance I had had so much difficulty trying to locate phenomena that we had decided to introduce this definite mark of the room's extent as a possible aid in this direction. It was pointed out that nobody "need" see the lights save me—we did not tell him outright that nobody could see them if he sat quiet—and that accordingly nobody need be distracted by them. Considerable phenomena had been produced, barring the plea that they distracted the spirits, so the explanation was accepted, how willingly I do not know.

It had been found that, even with a poverty of phenomena, we could not remember the sequence of the seance sufficiently well. We therefore called in the aid of the Dictograph Products Company, and they supplied us one of their machines. On Tuesday we put the transmitter on the shelf with the electric fan; on Thursday, on top of the lower sash of one of the windows, quite behind the black screen and out of sight. The wires ran out of the window and to the adjoining room, where a stenographer was posted. Tests made it plain that he would miss some of the phenomena, so he was instructed to pay careful attention to my voice, which carries well and is easily identifiable over the wire. I commented upon the phenomena in appropriate fashion as they occurred, and the resulting transcript, pieced out from the memory of the sitters, gives a remarkable running account of the two seances at which this apparatus was employed. We even have such details as the songs sung and the times at which they were rendered—on Tuesday 21 titles were used, four of them being repeated. It will now be plain how we know the moment at which the medium announced his discovery of the range lights.

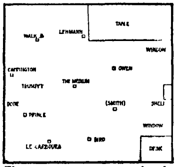
Tuesday's seance was marked by psychic lights, to the number of half a dozen or so. Here we came closer to the best standard than in any other phenomenon. But Messrs. Keating, Lescarboura and Lehmann, our electrical authorities, thought they could have been duplicated by draping an electric torch with vari-colored papers. In travelling range they fell short of proving their authenticity, if secured to anything as long as the dark trumpet they could easily have been manipulated from the circle, and in most cases actually from the medium's chair. One of them illuminated an object, apparently part of the light, which was variously compared to a melon and to the medium's bald head. It might equally have been the large end of the trumpet carrying the light. The lights were by no means sufficiently impressive to stand independently of the other phenomena.

At 10 25 there ensued a little incident which for a moment looked serious. It was the desire of the SCIENTIFIC AMERICAN to employ no rough tactics whatever, such as putting on lights, seizing trumpets, etc.; we believed that the true character of the phenomena, whether genuine or fraudulent, could be decided without such tactics. I can pledge that this attitude will mark all our seances. Mr. Keating was not aware of this, however, and either seized or tripped, or both, a "spirit" which was touching him with the

Our First Test Seances

(*Continued from page 14*)

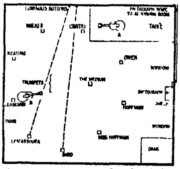
trumpet. As a result of this the trumpet was swung, apparently without expectation or intent on the part of the manipulator, and struck Mr. Walker rather harder than was in order for a well-conducted seance. Mr. Walker's first thought was of his glasses, and he seized the trumpet. A gentle tug failing to free it, Bert's voice shrieked "Don't do that", a violent tug was given, and the trumpet fell in sections to the floor.



The seating arrangements for the seance of Monday, May 21

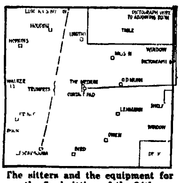
Mr. Walker, in his excitement, forgot that he had really seized the trumpet and insisted that he had only warded it off. Both the medium and his friend were equally positive in asserting that it had been seized and held. Granting that they were right, it would be interesting to have them explain, without incriminating themselves, how they knew it. Bert did not give it away, unless his exclamation quoted above were a code message. Mr. Walker's explanation and apology were finally accepted, and the sitting went on.

Thirteen minutes later, another interesting incident was had. At some indeterminate time before this, the trumpet had been doing stunts in my vicinity. When it ceased these I had a pretty good idea where it was, and that I could reach it with my feet. With no particular idea in mind, I tried this, and as I supposed succeeded. I certainly made no noise. At 10 38 Bert's voice came out of the air high in front of me, and had a long dialogue with me. First of all, he reproved me for sticking my feet out. I didn't have them out, and said so. He granted this, and explained that he meant before, when I had been "trying to trip a spirit." He laughed at me for not knowing that I couldn't do this. My explanation that I had not been trying to trip a spirit was at first rejected as false, and finally, I believe, accepted by Bert against his better judgment. I wondered whether what I had taken for the trumpet were the medium's foot.



Seats and apparatus for the sitting of Tuesday, May 22. A and B are the initial and final positions of the guitar, respectively

Bert and I then discussed at length the conditions. There was too much furniture in the room to suit Bert, and of the eleven sitters only six were really advantageous to the psychic power. He wouldn't specify, even when urged to do so, but he referred to Dr. Prince as a Doubting Thomas; this was presumably because of the incident of the evening before. Bert objected mildly to the presence of the books. He told me I was the best sitter there and I tried to make it appear that I appreciated the compliment. Finally he stated that they were about through for tonight, requested that a proposed sitting for Wednesday be deferred until Thursday, and promised us some perfectly gorgeous results on that occasion.



The sitters and the equipment for the final sitting of the 24th

At Thursday's session we had a definite problem to meet. We were assured that the occurrence of the phenomena coincided with the passage of an opaque object about the room. If in this connection we could be assured that the medium did not leave his chair, we should have proved that the phenomena were not due to his active intervention, unless he were bringing into the room something which could be found by searching him. If, on the other hand, we could prove that he did leave the chair at these times, it would seem fairly out of the question for him to hope to establish his phenomena as genuinely psychic.

We secured a piece of thin fiber board, two feet by one, with ten arched spring contacts on one side. These were sufficiently stiff so that, if placed on the floor beneath a chair, the weight of the chair alone would not bring any of them together, but the weight of a person sitting in the chair would surely close at least one of them. They were wired up in parallel, and the entire unit was in series with a battery and a lamp in the next room. With the board placed beneath a chair and properly connected, the remote lamp would burn so long as the chair was occupied, and would go out when the occupant arose. We tested it out thoroughly in the position in which it was aimed to use it, and found that I (weight, 125 pounds) could operate it infallibly. The medium weighs considerably more than this.

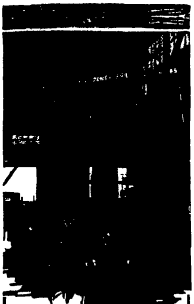
The detection mat was placed under the large rug that covers the floor of the library, with several small mats surrounding it there, to prevent its presence from making too marked a jumping-off place on the floor. The wire was carried under the rug and out the window, and an observer sat at the lamp in the adjoining room with the dictograph operator. Her sole function was to announce when the lamp went out, and, by means of a stop-watch, the period during which it remained out. These announcements were incorporated by the stenographer with his dictograph account.

We were faced with one difficulty, which we finally turned to an advantage. We must be assured that the chair was not moved about. We built up, of lathing, a cage on the floor that fitted snugly about the four legs of the chair. We tacked this to the carpet, anchored it further with adhesive tape, and made it solid at the corners. It was not at all immovable; one could have hitched the chair and carried it along. But we impressed upon the medium that we were anxious to be able to say, at the conclusion of the sitting, that none of the chairs had been moved. Those of the outer circle we had tied together securely with twine, but we pointed out that we could not run twine across the circle to his chair for fear of tripping the "psychic operators" or otherwise discommoding them. So we had adopted this device. It would not, to be sure, prevent him from moving his chair if he were bent on moving it, we pointed out, but it would make it possible, and easy, for him to occupy it for two hours without moving it. We had hoped that the insistence upon this perfectly absurd test might distract his attention from the real ones which we were using. Such distraction was a bit necessary, because one could sense the additional springiness of the floor under his chair—at least one could when one knew that there was something there.

As another item in this distraction (we were using the magician's stuff, it will be realized), we had the medium and his friend call at our office Wednesday afternoon for the purpose of discussing controls. We suggested several things that we had no intent of doing, to get their reactions. When we asked if there would be any objection to talcum powder on the floor, we were told no, but two points were made: first, the spirits would perhaps leave a trail in the talcum which might be mistaken for the trail of a human; second, we would have an awful time getting the rug clean again, and perhaps we would better realize this and put the talcum in pans, here and there about the floor. We were deeply touched by this solicitude.

It had been the medium's practice, in sitting at home, to employ, quite freely, luminous bands about the wrists of the sitters. We were going to follow this plan, and the medium knew it. Nothing was said to us about any departure from the procedure which one would suppose these bands to imply. We supplied bands of adhesive tape, with one or two luminous buttons pasted on each, and these were very effective in the darkness of the seance room. But when we got nicely settled in the dark, the medium suggested that we hide our wrists, and display them only on call, when phenomena had come and it was in order to account for all the sitters. As a matter of fact, this turned out to be a necessary step, because the presence of all those headlights was quite distracting, and with them visible, every scratch or wriggle by one of the sitters produced a shooting-star effect that was destructive to the morale of the whole circle. Yet under this procedure, the phenomenon is gone by the time wrists are called for and displayed. So this very much vaunted bit of dark-seance technique will not play any further part in our plans, and we shall attach no further value to seance reports where it is used as a control. In our own present case, however, it helped greatly in directing the medium's attention away from the things we were really banking on to check up on the phenomena. I think it will be agreed that this is a proper and very

(*Continued on page 64*)



Science Notes

Big Yale Telescope for South Africa?—It is possible that a powerful telescope will be placed somewhere in South Africa to view some stars which cannot be well studied from the northern hemisphere.

The British Museum Has No Place for Films.—Although the British Museum has over fifty miles of shelving for books they have no space for the safeguarding of historic films like those of the funeral of Queen Victoria The War Office has preserved films of the British Army during the war

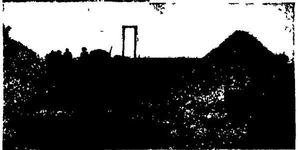
The Metric System.—The metric system is proceeding slowly as regards its adoption in English speaking countries. One suggestion which was made at a luncheon given in New York on May 5 by the Metric Association was that the conduct of international trade is at present hampered and confused by the circumstances that the content of the British gallon is greater than that of the American gallon The recommendation was made that both governments should abandon their standards and adopt in their place the liter as the common unit of capacity

Curious London Trades.—The London Blue Book is a ponderous tome, but contains some curious information London has a *solitary fisherwoman,* who lives in a suburb at Wandsworth it has one woman blacksmith, who works in Shoreditch, and there is one woman bricklayer, who resides at Deptford There are two London women who are gasfitters laborers While the county of London has but one fisherwoman the city of London (proper) has but one fisherman Among the queer trades are Hecklers," "jacquard punchers," "plunkers," "teasers," "slashers," "scratch brushers."

Petroleum Among the Ancients.—The oil industry had its birth in the United States about 1858 when crude oil was analyzed and a well was drilled at Titusville, Pa But our Indians, and the races before them knew crude oil Thousands of years before Christ, Babylonian and Chaldean masons used it in semi liquid form for cementing the bricks of their towering walls, and it was used in building the Pyramids. Herodotus mentions a well from which three substances, asphalt, salt and oil were pumped Oil from natural springs in Sicily was used in lamps in the temple of Jupiter at Rome, and the wealthy illuminated their homes with it. The ancient Chinese and the Persians used it for light and heat, and it enters into the preservatives of the Egyptian embalmers.

Cultivating Perfumes.—A process, the invention of M Daniel professor of botany at Rennes, by which the perfume of flowers is greatly increased has been explained before the Académie des Sciences in Paris By taking two plants of the same species and grafting one on the other—notably a wormwood on a chrysanthemum—he found not only that the grafted wormwood developed remarkably, but its flowers gave forth a perfume much more powerful than that of the original plant Moreover, the chrysanthemum had given to the wormwood flower something of its own perfume The professor collected the seeds of the grafted wormwood and the following year obtained from them some fine plants. They had this peculiar feature—that while the flowers of some of the plants emitted a perfume similar to those of the original graft, others were absolutely without odor

A Gas Celebration.—The Consolidated Gas Company of New York City recently celebrated their centenary The first plant of the old company was built at Hester and Rhynder (now Center) Street, and one mile of three inch main was laid in Broadway The first gas street lamp lighted was at Wall Street and Broadway, and a crowd keeping at a respectable distance because of the fancied danger of an explosion witnessed the ceremony The house of Samuel Leggett, president of the company at 7 Cherry Street, was the first house in New York City to have gas illumination The first gas container of the old company had 18,000 cubic feet of gas and the superintendent was criticised for extravagance for erecting one of such large capacity Today in Astoria, L I., the Consolidated Gas Company has a series of gas holders, two of which, the largest in the world, have a capacity of 15,000,000 cubic feet each In 1826 the cost of gas to the consumer was $10 a thousand cubic feet. It had fallen to $7 by 1834, but jumped back to $8 later because of the increased cost of materials.



Science Notes

Forty Million Marks for an Elephant and a Hippopotamus.—Hanover has been obliged to sell part of the Zoo. A French animal show paid 40,000,000 marks for the two animals named above.

How France Solved Daylight Saving.—Summer time received a set back when the French Cabinet decided not to interfere with Standard time, but that everything should start half an hour earlier Noon trains leave at 11:30, the theaters raise their curtains at 8 instead of 8.30, and so on

Spiritualist Sunday Schools Attacked.—Spiritualistic Sunday Schools are making a certain amount of progress in England. About 18,000 attend such services. Efforts are being made to influence some of them to become mediums. This has resulted in powerful attacks backed by well known persons.

Greece Adopts the Gregorian Calendar.—Beginning with March the Gregorian calendar was adopted for civil purposes in Greece. As Russia has apparently adopted the same course the old, or Julian style, has become practically obsolete The Greek Church is not at present adopting the reform, the reason being the expectation of the speedy adoption of other calendar changes in the west, for which it prefers to wait.

Will Map Europe's Sky.—A plan to map the entire sky of Europe is being carried out under the direction of the National Weather Bureau, which already has mapped the sky of France. Weather observers and amateur photographers of the Continent will be asked to assist. The photographers will be asked to make daily exposures over a period of a week or two. The photographs will be sent to the National Weather Bureau, where the causes of the weather conditions at the time will be retraced from them

Hockey in Ancient Greece.—An ancient Greek sculptured relief recently discovered in Athens, according to the London *Times*, gives evidence that the Greeks played ball games other than with the hand The relief represents six naked youths taking part in a game bearing every resemblance to modern hockey The curved stick used may possibly supply an explanation of the singular curved object carved in relief on some of the votive offerings found at Sparta. These have been called "sickles." It is difficult to say why this implement should have been dedicated to Artemis, but the word "sickle" may have been the current slang for a boy's hockey stick.

Radio Messages in Thunderstorms.—The Weather Bureau, although without facilities of its own for conducting investigations in this field, has cooperated in various ways with other agencies also interested in conditions affecting wireless telephony As a result of work done by Nebraska Wesleyan University based on thunderstorm reports furnished by the Weather Bureau the investigators reached the conclusion that there is no relation between barometric pressure and audibility, and that conditions at the sending station do not influence the audibility at a distant receiving station High static frequency, high static audibility and a nearby thunderstorm area, however, tend to reduce the audibility at the receiving station

Jungle Instincts of Caged Animals.—Wild animals in captivity live at night an imaginative life entirely different from their dull day hours when the curious file by in front of their cages, according to Mr R T Pocock, superintendent of the Zoological Gardens of London, who is about to retire after many years of service At night, he says, the inborn habits of the jungle show themselves in striking fashion, and the beasts throw off the sleepy veneer of indifference they seem to adopt when humans stand in front of their enclosures and speculate upon what might happen were the animals suddenly given their liberty "If you go into the lions' house during the day you are nearly always impressed by the peaceful way in which the animals regard you. But visit them in the darkness and instantly you are aware of the change *As if by magic their instincts to hunt and to kill have returned.* Nothing is more weird than to walk past the cage of a lion or a tiger and then turn around. To your astonishment you see that the animal has been stalking you just as if he were still living in natural surroundings. The instant you turn your head he drops flat on the floor of the cage." Mr. Pocock believes that wild animals never make good pets and that man has domesticated every animal worth while.

Electrical Notes

Rubber-Covered Tools.—While there is nothing new in rubber-covered tools, it is only of late that such excellent insulation is available on pliers, screw drivers, and other tools for electrical work. The insulation in this case is soft rubber, which will not harden or lose its insulating properties for a long period of service. One line of soft rubber-insulated tools is guaranteed to be tested for 100,000 volts applied for five minutes, which is obviously a more severe test than the tools are ever likely to receive in the usual run of work.

The Largest Waterwheel Generator Yet Made has been ordered by the Niagara Falls Power Company for its No. 3 power station and is the first of two units of the same size being built in the General Electric shops. Each generator will weigh 700 tons and will be 26 feet high and 35 feet in diameter. Both as to size and capacity they are the largest in the world. They will be driven by 70,000 horsepower hydraulic turbines made by the I. P. Morris Department of William Cramp Sons Ship-building and Engine Company of Philadelphia. Each generator will have a rating of 65,000 kilovolt amperes.

The Longest Submarine Power Cable in the world, according to Japanese claims, has recently been laid and is now transmitting power from Niihama to Shisakajima, Shikouku. The cable is about 13 miles long, and consists of 23 factory lengths each measuring 3000 feet. The cable is composed of three sector-shaped conductors having a cross-sectional area of 100,000 circular mills each. Each conductor is insulated with impregnated paper and the three conductors are wrapped with the same material and enclosed in a lead sheath. Around the sheath, continues *Electrical World*, is a jute bedding wrapped with galvanised-iron wire armor served with jute yarn. The cable contains four copper tapes within the outer belt insulation. These tapes serve as a protection of the power conductors and are also used for two telephone circuits. The finished cable is three inches in diameter and weighs 6.3 tons per 1000 feet. It was tested at a pressure exceeding the working pressure (namely, 11,000 volts) by 50 per cent after the cable was laid.

Cooling Storage Batteries.—At several of the sub-stations of the Southern California Edison Company in the San Joaquin Valley, where the summer temperature is often very high, the storage batteries used for oil switch tripping and emergency lighting have been installed in the ground to keep them cool. The sub-station buildings have glass sides, and although this is an advantage from the standpoint of lighting and fireproof construction, the temperature in the buildings in the summer is often considerably higher than the outside air. As a result of this condition the storage batteries are installed in sections of concrete pipe placed just below the surface of the ground, where the temperature is considerably lower than in the sub-station buildings. These sections of pipe are placed on end in the ground in holes dug for them. After the necessary conduit for the wiring has been installed, a concrete slab is poured in the bottom of the pipe for the batteries to rest on. A cover made of cast concrete is used. An additional galvanized cover is provided to prevent collection of water in rainy weather.

Cooling Methods for Large Transformers.—Only two methods of cooling large power transformers are being considered today in Europe. In one of these methods, continues *Elektrische Betrieb*, the hot oil from the transformer is pumped through an oil pipe system, over which a shower of water is directed. Being arranged within a cooling tower, the same water is used over and over again. The method requires one oil pump and one water pump. The second method dispenses with water entirely and directs a powerful blast of air across the oil-pipe system, requiring one oil pump and one air blower. Experiences obtained on the 100,000-volt transmission systems of Germany have shown that the second method, in spite of its higher initial cost, is more economical and reliable in operation, particularly where the water conditions are not perfect, as when only impure or carbonated water is available. The heated air, after leaving the oil pipe system, can be and is being used advantageously to heat the operating rooms of the station or sub-station, whereas with the first mentioned method a special steam-heating plant has to be provided.

Electrical Notes

Electrification of the French Railways, involving of five billion francs during a period of ten years, is the program of the French Government, which has approved the immediate expenditure of 90,000,000 francs on the Paris-Ouest Orleans line and 124,000,000 francs on the Midi line.

Electrical Heating for a "Shrink" Fit.—In order to fasten securely the shaft of a 4000-kilowatt rolling motor into its large rotor casting, a "shrink fit" was decided upon The necessary shrinkage was calculated to be from 0 5 millimeters to 0 6 millimeters, requiring the heating of the bulky casting to about 200 degrees Centigrade to 220 degrees Centigrade To accomplish this without undue loss of time and with greatest accuracy, electric heating was resorted to, using alternating current in a few turns of cable around the rotor hub as a short circuited secondary A number of calibrated thermocouples, placed at different points on the hub measured the rising temperature during the process. The job was successfully finished in 16 hours, consuming 50 kilowatts, of which 3½ kilowatts were the copper losses in the cable

Permanent Magnet Steel.—Extensive research work carried on in the Physikalisch Technische Reichsanstaldt—the Bureau of Standards of Germany—with various steel alloys suitable for permanent magnets resulted in the discovery of an alloy steel with considerably improved magnetic properties. Based upon previous tests on iron-manganese steel with an addition of cobalt, the saturation of the steel has been increased beyond values previously known on chromium and tungsten steel, according to *Electrical World.* A further improvement was achieved by adding 5 per cent of chromium resulting in a three times higher product of remanence and coercive force The best results were obtained with an alloy containing 1 1 per cent carbon 3 5 per cent manganese 36 per cent cobalt, 4 8 per cent chromium and 54 6 per cent iron

Electric Heating of Large Buildings is a subject discussed at length in a recent issue of *The Electrician* The following interesting figures are cited in connecting the heating requirements and the electrical load necessary to fulfill them In theaters, which are very economical places to heat, owing to the absence of outside windows 10 or 15 degrees' rise over the outside temperature is sufficient. Electrically this means 300 watts per 1000 cubic feet. In domestic work a useful semi "rule-of thumb' method is to allow 0 9 watt per cubic foot for a 30-degree rise of temperature per hour, or 0 6 watt per cubic foot for a 20-degree rise. These figures predicate the use of central heating apparatus only If ordinary fires, either coal or electric, are used in addition, the figures given above may be reduced 50 per cent. It may be mentioned that this data is based on the heating engineer's rule of 18 square feet of heating surface per 1000 cubic feet of space It may be added that the success or failure of any particular installation largely depends on the positions where the apparatus is installed. In rooms a position under the windows is the best place, but in large halls and churches, places in the roof or half way up the supporting columns may be used with advantage to counteract down-drafts and to obtain that even heating effect which is so desirable, and this effect is assisted by dividing the heating surface into small units. In this way, too a great reduction in the electrical load required can also be effected, as witness a case at Edinburgh wherein a normal heating load of 500 kilowatts are reduced to 64 kilowatts and space was saved by placing the heaters on the supporting columns. Various types of electric heaters may be employed, such as the straight electric heater with resistance wire for generating heat which is imparted directly to the air or, in the form of radiant heat, is directed toward the portion of the premises to be heated, or combination electric-steam radiators, in which electric heaters produce steam in a small radiator unit. The electric system of heating has the great advantages of responsiveness and easy regulation In an ordinary central heating system control is difficult and can only be effected from one point. In this system each radiator is complete in itself and can be turned on, off or down as required. In heating churches by ordinary hot water equipment it is necessary to fire up some 48 hours before. With electric heating this preliminary period is reduced to four or five hours.

Mechanical Engineering Notes

Magnetic Separation of Coal From Slag has largely replaced the older method of separation by varying specific gravity wherein water was used By the dry magnetic system the varying magnetic properties of the ferric oxide resulting from combustion of the iron pyrites and the combustible matter are used.

Brass Casting.—Not many years ago the chemist was unknown in the brass business, the caster playing "chemist" himself The master casters mixed their brass alloy with a great deal of mystery but very little exact knowledge. Nowadays the temper of the brass is tested by pyrometers, mercurous nitrate and photo-micrographs, while hydrostatic and other tests expose its weakness.

Keeping Valves Clean.—First put into practice by an automobilist to keep the carbon down, this dodge looks as though it might have a more general application. A simple lock washer was put on the valve stem, just below the valve, and as the valve moved up and down, this washer was brought into contact with the bearing surface every time the valve rose The result was a valve always free from carbon

Centrifugally Cast Iron Pipe requires heat treatment because the molten iron, being thrown against a rapidly revolving water-cooled metal mold is more or less chilled and, when the pipes are removed from the machine, they are more or less hard and brittle Pipe made in sand molds do not have to be heat treated The furnace used is oil fired, its heat being controlled by a pyrometer

Aluminum Solders cannot employ the ordinary soldering metals, excepting magnesium because they are electro positive to aluminum and thus act electrolytically in the presence of moisture as positive galvanic poles, accelerating the corrosion of the aluminum. Magnesium however disintegrates rapidly in the presence of moisture There fore the soldered joints should be protected by paint or varnish Zinc tin and zinc-tin aluminum solders give the best results.

Eyesight in Factories is the subject of an article in the *American Machinist*, wherein is stated that it is almost impossible to find a man with perfect eyesight after the age of 40 An examination of more than 10,000 employes in factories showed that 53 per cent had uncorrected faulty vision Shop accidents, on this account occur more frequently in the dark winter months. Painting the factory walls white will not only reduce this trouble but will cut down the light bill

Zirconium in Heat-Treated Steels.—A writer in *The Iron Age* states that ordinary carbon steels in which a small percentage of zirconium has been incorporated may be made to possess by suitable heat treatment physical characteristics approaching those of the highest grade heat treated alloy steels. Additional experimentation has demonstrated that the properties of a number of the well known alloy steels may be improved through the use of zirconium Also that by zirconium treatment it is sometimes possible to use advantageously the ordinary alloying elements in less than normal proportions.

Corrosion Process.—A writer in a recent issue of *General Electric Review* states that much may be learned in a very short time about the corrosion resisting properties of steel by observing the action of a drop of water upon the polished surface of the metal. Drops of distilled water in equilibrium with the air of the laboratory were placed upon various steel surfaces. In the case of pure iron, corrosion began almost immediately, and at the end of a few minutes the corrosion product could be seen distributing itself, always according to the same pattern Three distinct zones developed an outer one, which has been called by us the "immune" zone an inner one, which occupied a large part of the area of the drop, and a "wall" zone, which lay between the outer and the inner zone The outer zone was perhaps one-half mm in width, and the wall zone was best described as a line. The iron rust was evenly distributed over the level on the wall zone and the outer or immune zone was entirely free from deposits of any kind The length of time elapsing before the first appearance of rust, and the amount of rust present after the drop has evaporated vary greatly with different steels and form the criterion for judging the corrosion excellence of the particular steel under examination by this simple test.

Civil Engineering Notes

Steel Passenger Cars for India are being made. These will be 68 feet long and will have seating capacity for 100 passengers.

The Proposed Mid-Scotland Ship Canal for the navigation of large ocean steamers between the east and west of Scotland is now under discussion

The Railways of the World had an aggregate length of 748,000 miles in 1920. Of this trackage North and South America had approximately 50 per cent, Europe 30 per cent, Asia 10 per cent, Africa 4 per cent, and Australia 3 per cent.

Permanent Headboards between the sections of sleeping cars are a new equipment of the Pullman car The headboards extend out half way from the side of the car to the aisle and give a partial sense of privacy to the occupant of the section

Two 165-Foot Girders which were shipped from Milwaukee to Eola, Ill., required nine platform cars and were the longest single-piece shipment ever made by rail Each girder weighed 86 tons and was supported by bolsters at either end, the intervening cars rolling idle

A Cantilever Roofed Stadium for the 1924 Olympic games is to be constructed at Paris. The roof will overhang a distance of 131 feet, the principle of the cantilever being used permitting support at the rear This obviates the undesirable obstructions to view in front of the spectators.

An Underground Moving Pathway for Paris is the subject of investigation in that city Thirteen plans were submitted and five were retained for further experiments. Of these, four work on the principle of parallel bands working at graduated speeds, and the remaining one slows down for each stop.

A Six-Wheel Truck for Freight Cars has been perfected and tried out by a Baltimore steel manufactory In these trucks each axle is free to assume its true radial position on curves. The center axle acts as the pivot and the other two are hinged to its front and rear sides. Its purpose is to lessen resistance on curves and to cut down wear on both wheels and tracks.

Roller Bearings for Locomotives are being tried out in Sweden, after the failure of ball bearings to stand up under the heavy work. The locomotive department of the Swedish State Railways states, according to *The Engineer*, that the tests with this bearing have not continued sufficiently long to prove whether the arrangement is entirely satisfactory for locomotives.

Ship Salvaging has within the last 20 years been put on a vastly more practicable basis owing to the development of underwater tools such as the oxy acetylene torch, and underwater pneumatic tools such as hammers, chippers and drills. The telephone is a great help in intelligently and rapidly coordinating the work of the divers. The gasoline engine has made practical the use of small light power units for running air-compressors, centrifugal pumps and dynamos.

The Steam Road Wagon is used quite widely in England owing to the comparative cheapness of coke fuel as compared with gasoline. The road wagon takes the place of the ordinary truck as used for short freight hauls in America. The economic limits of the steam wagon haulage lie between a five-mile minimum and a maximum of 40 miles. They haul over the roads a useful load of about ten tons and get about ten miles per hundred pounds of coke and twenty miles per hundred pounds of Welsh coal.

Merchant Ships of the World.—The need of a work on merchant shipping, corresponding to the well-known annals of Brassey and Jane on the navies of the world has been met by the publication of a volume of 500 pages, entitled "Merchant Ships of the World." Like the books mentioned it is an annual, and both the editor, Frank C. Bowen, and the publishers, Sampson, Low, Marston & Co., are to be congratulated on the thoroughness with which the work has been done. The ships are classified under the countries to which they belong and arranged in alphabetical order, and an illustration is given of the most important ships and of one of each class of ships. The information includes the date, gross tonnage, draft and speed, deadweight, number of holds, size of largest hatches, as well as the length, displacement, details of engine and boiler plant, fuel capacity and the number of passengers carried. The pages measure 8¾ by 12 inches.

Miscellaneous Notes

Water at Auction.—Aden is one of the hottest places on earth A heavy rainfall recently filled tanks with 3,000,000 gallons of water which was sold at auction

National Park for Poles.—The Society of Friends of the Tatra Mountains, Poland, is working out a plan for transforming the mountains into a national park on the lines of Yellowstone Park.

Esperanto Congress. — An Esperanto Congress will be held at Nuremburg, August 2 to 8, 1923. Thirty five countries will send 2500 delegates A play, Lessing's "Nathan the Wise" will be given in Esperanto.

Ontario Gold Fields.—The gold fields of Ontario have been producing gold for several years, the output of ore having warranted large extension in milling plants The newly discovered gold fields of Labrador may prove to be a second Klondike

The Largest Thermometer.—Atlantic City has many novelties to interest visitors. Recently a thermometer 50 feet high has been erected Promenaders on the board walk can read the temperature a mile away Lights on the board indicate the temperature.

An Expensive Hobby.—A stamp exhibition in London has been insured for nearly $10,000 000 One single collection was insured for $500,000 One advantage of a stamp collection is its extreme portability All the stamps in the world in albums would only fill a small steamer trunk

A Large Envelope Order.—It will require 354,888,000 envelopes to inclose the mail of the Government next year and, as an indication of what these figures mean, the Post Office Department announced today that a contract had been let for 140,000 000 official envelopes for that department alone at a cost of $178,001

Traffic Troubles of Paris.—There are 80,000 automobiles in the streets of Paris 1000 cumbersome autobuses 1200 street cars, 400,000 bicycles considered the worst pest of all, 19,000 motorcycles, and 30 000 horse drawn vehicles. Everyone who has been in Paris knows that it is as much as one's life is worth to cross any of the principal thoroughfares. Traffic regulation is poor and the laws favor the drivers There is practically no speed limit and the drivers are very reckless, caring nothing for pedestrians.

Shortening Our Flag.—A reduction of twelve and one-tenth per cent in the length of our national flag has been decided on by the Fine Arts Commission as being the most artistic proportion Flags of all countries are made up according to well established mathematical rules and there should be no sentiment about changing an elongated flag to one of better proportions. In consultation with a committee of Government officials appointed for the standardization of the flag, the commission decided on a ratio of 1 67 to 1 instead of the present 1.90 to 1 The decision was reached through tests of various sized flags flown from the Arlington Amphitheater flagpole.

English Banknote Paper.—Paper for English banknotes is made at a paper mill in Laverstoke, near Windsor, where paper for Bank of England notes has been produced since 1724 No visitors are ever allowed except when there is a Royal visit, as occurred lately The King, Queen and other members of the party were shown through the plant and the many secrets of manufacture were explained to them The mill was started by a French Huguenot of Poitiers named Portal, who established himself at Laverstoke in 1719 Before Henri Portal undertook the manufacture of the paper, banknotes contained no water mark, but he introduced a water-mark consisting of a looped border running round the outside of the note and on the left-hand side a somewhat intricate scroll. At first the banknote paper, enclosed "in elm chests with locks and bound with iron," was conveyed by road to Newbury and thence by barge to London, but in 1781 Henry Portal, as he had now become, conveyed it in his own wagon to London The family monopoly which has existed for 199 years was not held without a struggle in the early days, for the records of the firm in 1737 show that There was an opposition at this time by One Judd at Yewell paper-mill by which means ye Price was lowered 18 p. Ream, and the duty Felting and carrg to London all struck off & to be pd and done by ye Maker

Our First Test Seances

(Continued from page 56)

desirable thing, regardless of whether he be believed genuine or fraudulent, or whether no opinion at all be held as to his status.

The arrangement of all the chairs was necessarily fixed before the medium's arrival, he first saw the room after it had been completely dressed up in twine and wooden strips. He entered the room with a demand on his lips for a complete rearrangement of the position and orientation of the chairs, on the ground that the psychic currents would be benefited thereby We pointed out how much work would have to be undone, and promised such a change, to be made to his dictation, the next time we sat. He let the matter drop there, which I thought indicated lack of confidence in the argument he had been advancing

We came near total disruption right at the start. Mr Orson Munn was in attendance, with a young lady friend She had not been told just what might happen, and when, shortly after the darkness descended, the spirits selected her for the first touch, she gave forth a shriek that might have been heard blocks away The medium was very much shaken up by this, but the young lady was quieted and the seance went on

We had a sitting richer in phenomena than Monday's, but poorer than Tuesday's. Again the medium displayed too much knowledge of what was going on The trumpet crashed to the floor between Houdini and Mr Hopkins, and they were uncertain whether to recover it or to let it alone. Without their having given expression to this bewilderment, the medium stated that they were excited and leaning over the trumpet to pick it up, and warned them not to do so The accusation was in accord with the facts.

Under hypothesis of fraud, little was done that would have called the medium out of his seat. When anything of this character did occur, however, the record showed, without exception, that he was out of it. In all he left it fifteen times, for periods as long as 15 seconds at a time. There can of course be no valid reason for this; and, since he was not in trance, not even a valid excuse The parallelism between the absences of the medium from his chair, and the phenomena, is displayed elsewhere. It should be emphasized that all his absences from the chair are listed in the table on page 14

During the evening the medium discovered and questioned the softness of the floor under his chair The stenographer missed this incident It was apparently between 9 45 and 10 o'clock after the preliminary exploration of the circle with a trumpet from the medium's chair had been completed, and the phenomena involving his movement had begun, and also after he stopped his free circulation at 9 45. If one might hazard a guess as to what happened, it would be based upon the fact that the medium's movements were on this evening audible for the first time This would argue that he is accustomed to shuffling noiselessly about a flat floor, but that one with a little hill under his chair would make him a trifle awkward, and would finally obtrude itself upon his consciousness. After nine comings and goings in nine minutes, he would have sensed the presence of the obstruction, and explored it thoroughly by hand, to assure himself that it was there. Then he would have slowed down materially the tempo of the seance, and that this slowing down had occurred all the sitters realized, even before the sitting broke up and we had time to cast an eye at the records in the next room.

For one more incident of this final seance I must find space, if it involves lifting a column of advertising to make room for it! On Tuesday a whispering voice had presented itself to me, quite close, attempting to articulate a word of two syllables. I and my neighbors at first judged this to be a name. We all strained our ears to catch it, and it was repeated twenty times at least. I encouraged this to go on until I had fully satisfied myself that it was in fact wholly inarticulate, and that anything which it might be understood to have said would have been wholly due to the listener's imagination Then I encouraged it to stop, and it stopped.

One of the known tricks of questionable mediums is to give such inarticulate sounds, hoping that the sitter will identify them through such active imagination and active desire for the presence of some dead friend as he may have. When it works, it usually "goes big", the sitter feeds out all sorts of information about the departed one, and promptly gets it back from the voices. I determined to learn, if this whisper was re-

peated on Thursday, whether it would do this.

That the spirits had picked me out of the crowd was plain from the beginning of Thursday's sitting. I got ten touches to every one by anybody else. Finally sure enough, the same hoarse whisper came to me. I had, on Tuesday, suggested that it was trying to pronounce my name Over the interval it had adopted this suggestion and made it its own for now it said Hello Malcolm,' as plainly as human being could possibly whisper these words The following dialogue is not necessarily an exact transcript of what ensued, but it is sufficiently so to stand as a faithful account of the incident, in spirit if not in every letter

Bird Yes, this is Malcolm Who are you?

Voice Wa-wa (I adopt this purely arbitrary symbol for a whispered murmur that was absolutely without articulate form)

Bird I don t quite get it try again

Voice Wa wa

Bird Who did you say?

Voice Wa wa

Bird (*stalling desperately while trying to think of a name different from that of any deceased relative or friend*) Did you say Harry?

Voice (joyfully and with absolute clarity) Yes, Harry

Bird Oh, Harry you said is that you Harry?

Voice Yes it is Harry

Bird (after giving it time to wa wa some more which it wouldn t do) Well Harry that's fine But Harry suppose you try to give me your last name It would be quite evidential if you could do that.

Voice Wa wa

After it had wa wa-ed several times and I had encouraged it each time, I finally was able to dig out of nowhere a name that I was certain meant nothing to me Meyer I supplied it as I had supplied the Harry and the voice immediately became articulate long enough to say Yes Meyer Harry Meyer" Then it lapsed into wa wa again

I was extremely interested to learn how long I could keep this business up and how long Harry would keep it up So while I was inventing a collision between an automobile and a telephone pole which might *reasonably stand as the agency of Harry's* demise, I got off some such patter as the following punctuated by Harry's faithful wa wa ing at appropriate intervals.

Suppose you speak to me Harry see whether you can tell me something of the circumstances under which you died"

Here Harry recovered from the wa wa's sufficiently to articulate distinctly that he never had died I explained to the company that I had inadvertently used the wrong word *that Harry's expression for what had* happened to him would be "passed on" I substituted this and renewed the inquiry and Harry lost his command of English and relapsed into the wa wa tongue again But I stuck to the subject

'Come, Harry, can't you give me something about the manner in which you passed away? Perhaps you can indicate whether you died a violent death? Did you pass over by violence, Harry? Did you (here I made what I hoped would stand *for a painful* effort to select words that should not reveal too much) pass on suddenly? Was it—was it an accident?"

At this stage Harry was convinced that it must have been an accident, and he regained his speech long enough to say 'Yes" most emphatically But my construction of a personal identity for him was rudely interrupted My colleagues, Messrs. Walker, Lescarboura and Munn had been struggling with their risibilities for some time Mr Munn's sense of the humor of the situation got away from him and to my horror I heard a loud snicker from his direction The percussion set off the two gentlemen at my right, who burst into outright laughter

I was afraid that everything was off, but I tried to save something from the wreck by saying, in as severe a tone as I could muster: "Gentlemen there is nothing to laugh at." This was effective in silencing them but unfortunately for the continuation of my demonstration with Harry Meyer Mr Smith took the cue from me and proceeded to read them a lecture which was even funnier than my efforts to drag articulate speech out of Harry He indorsed my remarks thoroughly and enthusiastically, stating with great severity that this was a mighty solemn occasion, and that it was painful indeed to have it marred by mockery That it was a very serious and solemn and sacred business being thus led into the presence of the dead, and

(*Continued on page 69*)

Radio Notes

Static, as a matter of fact, does not hinder radio telephone reception to an alarming extent. In this respect radio telephony has one great advantage over radio telegraphy. For instance, speech can be carried on after a fashion in extremely noisy public assemblies. The ease in understanding speech under such circumstances is due to our life-long experience. Then, too, there is what may be termed "assistance of context." By this is meant the ability of the average listener to fill in lost words which make sense to the entire sentence. However, static is disagreeable, especially when listening to something quite specific such as figures, prize fight reports from the ringside, baseball games, and so on. Since static and signal are amplified alike, it would seem advisable to suggest less frequent use of the loud-speaker in favor of head 'phones when intense static exists. Vacuum tube amplification, especially audio should be reduced to a minimum consistent with signal strength. At any rate, during the summer season it is well to give up long-distance or DX reception, and confine one's activities to the reception of nearby broadcasting stations with as small an aerial as possible, and without amplification. Amplification generally serves to increase the troublesome static in greater proportion, so it seems, than the music or talk being broadcasted.

An Unforeseen Expense.—It has been the custom of most radiophone broadcasting stations to ask their listeners to write in, 'phone, or telegraph, stating how the programs were being received. Until now no harm has ever come of this practice and, if anything, it has added another thrill to radio broadcasting. One station at least has been offering prizes for the first listener to report from each State. However, it remained for the mayor of San Francisco to add the proverbial straw which broke the camel's back, and the old established practice of soliciting telephone calls and telegrams and letters may have to be modified or made more plain in the future. At any rate, according to press accounts, it appears that Mayor Rolph, in dedicating a local broadcasting station, said into the transmitter: "I want to find how far my voice is carrying, how big my audience is. Send me telegrams and send them collect. Come on—everybody. Mayor Hylan, of New York, and you, Mayor Curley of Boston—everybody!" Well, everybody must have responded. Telegrams piled up on the Mayor's desk. By the following day the telegraph tolls had already exceeded $3000 and were still rising. The Mayor, pleased at first, must have changed his mind later, but there was nothing to be done. He had called for such responses. In the future radio-phone speakers will no doubt be more modest in calling for telegraphic response from the audience, and will make it clear that such messages of appreciation must be paid in advance.

The Case of Loose Connections.—If there is one predominating cause of trouble at the bottom of radio failures, it is poor connections. The present radio broadcasting interest has passed into a new phase, the build-your-own phase, instead of the buy-a-complete-set phase of a year ago. As a consequence all kinds of receiving sets are to be seen, the result of good workmanship and poor workmanship, real knowledge of radio and almost total ignorance of its very essentials, and excellent parts and inferior parts. Many of the home-made contraptions of the poorer order are not functioning, and as a consequence the leading radio enthusiast of every locality has plenty to do in the way of dispensing radio advice and assistance. From our own personal observation we can state emphatically that nine-tenths of the radio failures are due to poor connections. Much of the cheap radio material now being sold is so poorly designed and constructed that a positive connection cannot be counted on. Variometers and vario-couplers of the cheap variety have poor connections between the rotor and the stationary member. Even if the connections have been properly made according to accepted hook-ups, one cannot rely on them because of the uncertainty of continuity. So, one of the first principles which should be observed by all builders of radio receiving sets, whether small or large, inexpensive or elaborate, is to make sure of every connection and, if possible, solder every splice. Little flexible jumpers or pig-tails should be used to make positive connections through variometers, vario-couplers and variable condensers of inferior construction.

Radio Notes

Radio and the Fishermen.—Herring fishermen off the Swedish coast are being kept posted on the location of schools of fish by radio telephone. These tips on the whereabouts of the herring have resulted in an increase of efficiency on the part of the fishing crews. On an average they return with a hold filled with fish more often than they have done before the installation of radio. Germany, it will be recalled, was the first country to make extensive use of radio in connection with fishing operations. However, the German application of radio was limited to radio telegraphy, and called for a knowledge of the telegraph code on the part of the fishermen making use of the service.

Wireless Telephony and Telegraphy Compared.—This is an abstract of a report of a sub-committee of the Radio Research Board of the Department of Scientific and Industrial Research. The possibility of establishing satisfactory radio telephone communication on a commercial basis for a distance of 3000 miles or more is considered to be remote. The power for radio telephone services is estimated to be from 3 to 20 times greater than that at present considered necessary for similar radio telegraph services for the same range. For medium ranges, say 1000 miles, the difficulty as regards a commercial service are practically the same as those for longer distances. The position as regards short-distance communication (200 miles or under) is considered to be more hopeful. The conditions requisite for a commercial service are enumerated and the extent to which these can be met is stated.

The Speaking Flame.—It begins to appear as though the carbon microphone which has long been employed for the conversion of sound waves into electrical variations in wire telephony and radio telephony, is doomed to extinction—at least as far as the radio end of its application is concerned. For wire telephony it must continue in use because it is simple and fairly efficient but for the transmission of radio programs the usual carbon microphone is by no means satisfactory. We have already told of the Pallo-photo-phone transmitter used in the WGY broadcasting station of the General Electric Company, and the glow transmitter in the KDKA Westinghouse station. Now we have to report the DeForest speaking flame transmitter, which is a development of Dr. DeForest's phonofilm or talking pictures. "Take the ordinary bat wing gas burner or a certain form of Welsbach mantel gas light, or special forms of oxy acetylene gas flames, insert two heat resisting electrodes therein, in proper relation to the flame and to each other, connect these electrodes to an appropriate electro-motive force, and you will then have an extremely sensitive sound converter which gives an electric reproduction of the sound waves in the air enveloping the flame which is of an entirely different order of fidelity from that ever obtained from any form of microphonic device, using a diaphragm, whether this be of the carbon, electro-magnetic, or electro-static variety" states Dr. DeForest. "In my phonofilm work we have found in the same way that when a series of very fine and very short platinum wires are heated to a dull red from a local source of current, the resistance of these wires changes, alternately increasing and decreasing in conformity with the sound waves impinging thereon, so that from a telephone transformer connected in series with a battery and this thermo-microphone, a remarkably faithful representation of the sound waves is obtained, even though the frequency of these be as high as 3000 per second. The sensitiveness of this device is greatly enhanced through a gentle stream of air, by fluid evaporation in the neighborhood, or by other auxiliary means. Of all the diaphragm types of transmitters, unquestionably the electro-static type as perfected by engineers of the Western Electric Company, comes nearest to approximate perfection. While this is extremely insensitive compared with the best carbon microphone types, there is no comparison between the fidelity of reproduction by the two means. But one listening in a telephone to the reproduction by means of the flame microphone, and then by means of the electro-static microphone, will at once exclaim that the fidelity of reproductions in the first case is of quite a different order from that obtained even from the highly perfected diaphragm of the best electro-static microphone."

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Radio Notes

Ocean Steamer Has Two-Way Radio.—On the last voyage of the White Star liner "Majestic" radio messages were exchanged with shore stations of the Radio Corporation at speeds of more than 80 words per minute when the vessel was a thousand miles at sea. In order to effect two-way high speed telegraphic service on the vessel it was equipped by the Marconi Company of England with a high-speed receiver which worked most satisfactorily. High-speed signals were also received from Paris at a distance of 800 miles at a speed of 80 words per minute.

The New Wave Length Regulations.—To clear up the muddle which has gradually come about as the result of the rapid growth of radio broadcasting and the unexpected multiplication of broadcasters, the Department of Commerce has issued a revised schedule of wave lengths which went into effect on May 15 last. The new schedule is the result of the extensive deliberations of the recent National Radio Conference which were discussed in past issues of this journal. In brief, definite wavelengths have been allocated to each of five zones into which the country has been divided, and broadcasting stations will have to adhere to these or suffer the penalty of loss or suspension of license.

For the Class B stations (the high power transmitting agencies) there will be ten wavelengths in each zone, and each of these will be adjusted so as not to conflict with any other.

Of the ten zone lengths assigned to Zone 1, which extends from New England through the District of Columbia, three of them, 405, 455, and 492 meters, have been assigned to New York City and Newark. This is because so many persons are served by the stations in the neighborhood, and so much entertainment talent is available. The stations in New York and Newark will have to arrange for division of time.

Other assignments of wavelengths thus far in this zone are

Springfield, Mass. (Westinghouse station) and Wellesley Hills, Mass., 337 meters.

Schenectady (General Electric) and Troy (Rensselaer Polytechnic), 380 meters, Philadelphia (Wanamaker's, Lit's, Strawbridge & Clothier), 509 and 395 meters, and Washington (Arlington and Radio Corporation) 435 meters. It is likely that Arlington will have a special wavelength and not be forced to divide time with any other station. Wavelengths of 303, 319, 460 meters also are reserved for this zone.

Assignments in the other zones up to this time are

Zone 2—Pittsburgh, 326, Chicago, 448, Davenport and Des Moines, 484, Detroit and Dearborn, 517, Cleveland and Toledo, 390, Cincinnati, 309, Madison and Minneapolis, 417.

Zone 3—Atlanta, 429, Louisville, 400, Memphis, 500, St. Louis, 546.

Zone 4—Lincoln, Neb. 341, Kansas City 411, Jefferson City, 441, Dallas and Fort Worth, 476, San Antonio, 385, Denver, 323, Omaha, 527.

Zone 5—Seattle, 492, Portland, 455, Salt Lake City, 312, San Francisco, 509 and 423, Los Angeles, 395 and 469, San Diego, 536.

None of the wavelengths goes above 600 meters. This is important to amateurs, as according to a plan proposed to the recent conference the large stations might have had wavelengths up to 700 meters, which would have necessitated the changing over of many receiving sets.

Besides the Class B stations, which broadcast to long distances, there are 540 Class A stations which use the 360-meter wavelength. These will be allowed to retain that wavelength or can come into a special band between 222 and 300 meters. If a new station is erected and it cannot meet the qualifications of a Class B station it will not be allowed to use 360 meters, but must go into the 222-300 band.

Because of the great activity in radio, the Department of Commerce is enlarging its forces in the inspection districts of which there are nine with Boston, New York, Baltimore, Atlanta, New Orleans, San Francisco, Seattle, Detroit, and Chicago as headquarters.

Beginning May 15, inspectors will check the wavelengths of stations in their districts.

It was stated that any station now operating on 360 meters has the privilege of remaining on that wavelength. It is also emphasized that the assignments of wavelengths are for cities and not for specific stations.

Our First Test Seances

(Continued from page 65)

that he was very sure that if any of these gentlemen were to think that his dear departed mother had come to him and he had met her with a sneer he would regret it for the rest of his life That he and the medium had come here to put this thing over, this great message. That they weren't here for the money prize that if the medium wanted only money, he (Mr Smith) had ten times $5000 in his pocket that he could hand right over to him. They had come here to put this thing over, so that we might all know about it, without any doubt or suspicion of fraud I had begun to fear that he would not finish at all, but he did with an exhortation for all of us to get in a real happy and receptive frame of mind for the phenomena But Harry was gone, and wouldn't come back.

Well there we are. I don't suppose it is necessary to state specifically that the name *Harry Meyer means absolutely* nothing to me or to insist again that while the 'spirit' voice which claimed that name was absolutely unable to make an articulate sound save in repeating what I had put into its mouth, in doing this it could talk as plainly as I can

Through a premature statement by a member of our committee the medium learned from the daily papers that he had been observed to be frequently out of his chair but he did not learn the observed coincidence of these absences with the major phenomena of the seance He called upon us immediately for the purpose of "explaining" the record The substance of this explanation was that at times during his seances he is lifted from his seat by the spirit forces In support of this claim, he reminded us that he had made it twice during the seance The fact is, however, that on neither of the occasions when he advanced the claim that he was being lifted did the light record his absence from the chair while both claims came after he had discovered the curious nature of the footing under the chair

In view then, of all the facts which I have put down, and of numerous others that have been squeezed out by the demands of space, the sub-Committee considering Mr X's mediumship finds it possible to make a definite report on the basis of these three sittings. This sub-Committee consists of Drs Prince and Carrington, and Houdini It finds that the medium has failed to give any evidence whatever that his mediumship is genuine It therefore rules (see the statement of the conditions of our offer in our January issue) that the medium has failed to qualify for further investigation by the sub-Committee or the full Committee that his mediumship stands rejected and that his claim to the prize and to the Committee s further attention stands vacated

Trapping the Burglar

(Continued from page 7)

burglars were not apprehended A good many innocent tramps and idle young men suffered jail terms to be sure, but the authentic robbers escaped

One of the worst sufferers by the misdeeds of the mysterious criminals was the owner of the local mill He had been burglarized at least a dozen times. Finally, without consulting anyone, he rigged a set-gun in his place and waited results At the end of the first week the miller found that his gun had been discharged and discovered traces of blood inside and outside his premises. A thin trickle of red was followed by the police and led to the home of Charles Adams, the town's first citizen After a dramatic trial Adams was sent to prison and later escaped, it is said, by inducing hypnotic sleep and being carried out of his gaol in a coffin.

Similar ironic comedies have followed the employment of the set gun in other communities. But pathetic or even tragic results have been the usual upshot of such drastic remedies, with the result that laws have been passed against this kind of thief traps in various localities.

The late war, with its vast employment of poison gases, has had a very definite effect upon the development of explosive thief catchers and burglar alarms. In New York City alone there are today a dozen makers of various kinds of asphyxiating devices aimed at the nocturnal prowler I remember with considerable nervousness my first contact with one of these mechanisms and its inventor He had followed me to a nearby summer resort for the purpose of demonstrating his goods and finally overtook me in the lobby of a certain famous hotel, where he backed me into a corner and brandished

a heavy cane in whose tip was a tear-gas bomb, powerful enough, he assured me, to "lay out every man, woman and child in this place." Soon afterwards he was committed to a sanitarium.

This is not told by way of reflecting upon gas bomb alarms and burglar protection in general. In cities like New York, Chicago, Philadelphia and Detroit a new kind of snatch-and-run robber has been operating for several years. Their practice is to smash a jeweller's window or pounce upon an exposed cashier, grab all the diamonds or cash within easy reach and run for it. The jobs are so quickly done that ordinary burglar alarms are useless. The robbers are gone before help can arrive. Against such snatch robberies the asphyxiating bomb has been considered highly useful, and a good many devices using such petards are now installed in several principal cities. I suppose there must be several thousand of them employed in New York.

To foil the payroll bandits infesting every city, cartridges containing chemicals which instantly give off an asphyxiating gas have also lately been fixed to the satchels which bank messengers and payroll auditors carry to and from banks with considerable amounts of cash. There are, to be sure, many other kinds of alarms designed for the protection of these money bags. One type starts a gong inside the satchel which cannot be shut off and continues to ring till the robber drops it or the mechanism runs down. Another type fires one or several cartridges to attract the attention of passersby or officers. Thus the gas bomb is only the latest development in this field.

Probably the most advanced and intricate system of burglary protection by means of asphyxiating gas has been invented and is being distributed by a veteran New York theatrical man. This gentleman affixes to doors and windows a simple enough mechanism which fires a shell containing salts that are instantly ignited and fill the room with choking fumes of sufficient power to lay out a burglar if he has managed to get inside, or definitely to repel him if he is still in the act of entering. At the same time the device sets off a series of rockets held in a bracket on the outside of the building. Up go the fireworks, exploding high in the air with loud detonations and showers of stars.

Attached to this arrangement is a numeral indicator on each floor of an office or loft building, which indicates by dropping a number the location of the burglarised room. A third connection sends the alarm to the nearest police and fire stations. The same inventor has worked out a system of protecting windows with hollow steel bars. In the core of each of these is a rolled sheeting of fulminate enclosing the gas salts. If an attempt is made to cut the bars the fulminate ignites, sets off the gas producing substance, blows poison fumes into the robber's face and fires the rockets.

Without in any way discounting the worth of such burglar defenses, their dangerous properties need to be recognised. Recently a police officer having seen a light burning within, entered premises in Thirtieth Street, New York. He was not aware that there was a gas alarm, with the result that the bomb was set off, the policeman was knocked unconscious and severely gassed. Such accidents are certainly likely to happen to users and to innocent visitors as well. Again, the danger to firemen in case of conflagrations must be considerable unless special defensive mechanisms or precautionary methods can be developed.

There seems to be no question that we shall shortly find ourselves in the midst of anti burglar and thief devices controlled by wireless. Here we shall probably have developments which will make all the curious miracles of the past in this field seem tawdry and pale.

Transplanting Insects' Heads

A REMARKABLE experiment has been tried at the Biological Research Laboratory of the Vienna Academy of Sciences by Dr Walter Finkler who, in order to solve certain problems connected with the correlation of body and soul, cut off and exchanged the heads of insects duly narcotised. The head having been lifted out of the thorax socket, was severed from the trunk by a simple stroke of the scissors and transferred to another individual treated in the same manner. The blood thus escaping, which, by the state of narcosis, was reduced to a minimum, immediately closed the edges of the wound and, without any seams or other means of fixation, merely in virtue of its natural adhesion, kept the head in the position most suitable for healing.

In order to test the functioning possibilities of transplanted heads, the behavior of beheaded insects was first investigated. A decapitated *Hydrophilus* was found unable to move about either in water or on the soil while all other insects submitted to these tests likewise proved incapable of any co-ordinated movement. All these phenomena, however, would disappear within two or three weeks of putting on a new head.

Our Psychic Investigation in Europe—III

(*Continued from page 20*)

diumship is more clearly drawn than some of us realise, more clearly perhaps than some of us find agreeable. That some mediums do employ fraud on occasion is admitted. This is explained on the ground that the medium is of intelligence just sufficient to feel that she is under fire and must make good, that her psychic powers are uncertain and often refuse her, and that when this occurs she produces as best she can the results which she feels to be imperative. This involves the assumption that there is such a thing as psychic power. We may, if we are able, refute this assumption by a showing of fact, but it is only after our assumption that we shall have the facts. Until then we may not quarrel with this assumption. It is one of several that have been advanced to explain certain observations, and we cannot throw it out any more summarily than we may throw out the explanation that all mediums are crooks.

Accordingly, it is not inconsistent, as might at first appear, to speak of a given psychic performance as partly genuine and partly fraudulent. It is regrettable, if the intelligence of the psychic sensitive is not sufficient to sort the two out for himself; but if it is not, and if we are to admit that genuine phenomena as well as fraudulent ones perhaps occur, we must come prepared to do our own sorting.

This is all very well, but the psychic proponent does not stop here. He wants us to deal in exactly the same way with the medium who has been caught faking, the medium against whom strong presumption of faking but no proof exists, and the medium against whom no good evidence of fraud has been found. This is altogether too severe a demand upon our patience. A highly prejudiced speaker in my presence recently pictured a psychic investigator as saying: "I have sat fifty times with this medium. Forty nine times I have caught her cheating. The other time I did not catch her. Therefore this fiftieth performance was genuine, and she is a great medium." This of course is grossly exaggerated, but it points in the right direction. We must avoid the error into which it assumes that we have fallen. The medium who is known to have cheated cannot possibly hope for such favorable treatment as the one who is not known to have cheated. Even the presumption that fraud has been committed, if a reasonable one, works the same way. And finally, to touch a sore spot: the knowledge that a given performance or a considerable part thereof can be duplicated by sleight of-hand does not prove anything at all against the medium. But in the presence of such knowledge we are certainly justified in meeting both the medium and the portions of his performance for which the conjurer has no present parallel, with a greater reserve than would be appropriate in its absence.

In the seance which I have described, the psychological arguments against fraud seem rather strong, but are of course far from conclusive. If we pass them over, we find that the greater part of the sitting could have been done, with comparative ease and little danger of detection, through fraud on the part of one or two of the sitters. There is no doubt in my mind that some at least of the phenomena were so produced. Where to draw the line and whether to draw it at all are questions of great difficulty. In spite of this, and with due admissions regarding the unsatisfactory conditions of the seance—a dark sitting with thirteen participants can never prove anything—it seems to me reasonably probable that genuine phenomena occurred. But I must emphasise that this is a purely personal judgment, formed upon grounds that are really inadequate for the formation of an opinion in which one can have confidence, formed upon these grounds only because they are the only grounds presenting themselves, and formed with full realisation of its inadequate character. And I must insist that it be not taken as a scientific opinion, or be quoted as scientific authority on behalf of the existence of psychic

phenomena. It really means nothing other than that, after attending this and other seances, the occurrence of genuine psychic phenomena of a physical character impresses itself upon me as less improbable than I should have judged it to be in the absence of this experience.

Elevation and Range of British Naval Guns

(*Continued from page 26*)

shock to which the structure is exposed when the gun comes crashing down in recoil. It may even be doubted whether the speed with which the gun can be loaded at so high an elevation is equal to that when it is nearer the horizontal. The net gain in all round efficiency is therefore decidedly problematical

The position, then, is this. The battle cruiser "Hood," armed with the 15-inch Mark I gun, firing a 1920 pound projectile at a muzzle velocity of 2450 foot-seconds can shoot 30,100 yards with her 30-degree mountings *But all the other ships of the British battle fleet have only 20 degrees of elevation* and their extreme range is therefore 24,000 or 20 000 yards, according to whether they carry the 15-inch or the 13 5-inch gun

There is an impression in England that the American fleet already includes several ships with their main battery guns mounted for at least 30 degrees' elevation, viz the 'Maryland,' Colorado," and West Virginia," if no others and as these vessels are armed with a 16 inch 45-caliber piece, their range, 30 degrees, ought to be well above that of the Hood's' 15 inch 42-caliber guns The popular notion that increased elevation gives much longer range is illusory For instance, if the "Hood's" guns were converted to 40 degrees, the gain in range would not be more than 4000 yards. Apart from the angle of firing, gun range may be increased either by using specially shaped projectiles—with stream lined "wind-cheating noses, like those used by the French at the land front during the war and similar to the German "Spitz Granate" employed for very long-range bombardment by heavy guns —or by reducing the factor of safety i. e, increasing the propellant charge or by listing the ship. All these expedients were tried during the war, but all have manifest drawbacks. Little need be said here as to the actual *military* value of what may be called super range in ships' artillery In theory hitting is possible up to the extreme limit of range, in practice, the percentage of hits obtained at anything above say 24,000 yards, on a target moving at high speed and on a varying course, would probably be nil

Industry in the Philippines

(*Continued from page 29*)

3,500,000 liters a year have to be imported to meet the demand. Filipinos are very moderate drinkers.

From liquor we can innocently pass to fruits of which the Philippines have innumerable varieties. The yearly yield of fruits of all kinds is estimated at $15,000,000 a year and is all locally consumed. The canning of mangoes, declared to be the choicest and most delicious fruit in the world, has been undertaken by Americans to let their brethren back home have a taste of the life of the tropics.

A study of industrial conditions in the Philippines would be incomplete if public utilities, of which we have too few, were left unmentioned

In the city of Manila an American company owns and operates the electric light, power and street-car service since 1905 The Manila Electric Company, a $14,000,000 property, operates 50 miles of trolley with 160 cars of American make and furnishes light and power to 87 000 customers. Its power plant, of 22 000 horsepower, is the most modern in the Far East, being equipped with the latest type of stokers and electric apparatus. The power is generated by steam, the coal used is anthracite from Indo-China, which is of the same character as Pennsylvania anthracite but with more heat units. The high tension and low tension electrical distributing systems comprise approximately 1000 miles. The poles are of concrete and Ipil, a Philippine wood The track construction consists of a generous foundation of crushed stone. High T rail of the type used in the United States is employed. The car house and repair shops are of cement and steel. Manila is justly proud of its most efficient public utility

Manila's telephone service is conceded to be the best in the Orient. There is a telephone to every 25 persons in Manila There is a gas corporation in the city which fur-

nishes gas for cooking purposes, and reports increasing patronage. The city has splendid water and sewerage systems. The firm that constructed them is responsible also for most of the bridges, edifices and other constructions in the country It has iron and brass foundries and modern shops manufacturing steel structures, steel barges, tugs, also bolts, knots and shapes. The raw materials are imported from the United States. There are slipways, ship yards, drydocks and big ship repair shops. The building industry is a growing one Commodious buildings in Manila are being built of reinforced concrete. All public buildings are similarly built.

The Manila Railroad Company, a Government-owned line, has a mileage of 646 in operation The road is 42 inch gage. The line is laid with 65-pound rail The original construction was English as well as the equipment The unit of the original rolling outfit is a seven ton, four-wheel box and the engines were from 18 to 30 tons dead weight. Recently Porter 72 ton and American 124 and 127 ton locomotives were added to the equipment. The line is being Americanised in equipment to promote efficiency The line which traverses a wonderfully fertile country is very valuable property and a bright future is generally predicted for it.

The Philippine Railway Company, an American company, operates 72 miles of main line on the island of Panay and 59 miles on the island of Cebu, which are both fast-developing territories.

Hydroelectric power is not yet harnessed The Agus River in Midanao is estimated to be able to develop 350 000 horsepower, the Agos River in Tayabas, 55 000 horsepower, the Angat River in Bulacan, 9000 horsepower and the Agno River in Pangasinan, 80,000 horsepower Extensive irrigation projects have been constructed, and it is expected that the production of rice the first article of diet of the people, will be increased to meet the demand without importing any from abroad.

Underpinning the Washington Monument

(*Continued from page 32*)

ing from the top of the slab, on a line 13 feet and ¾ inch inward from its outer face, there was built a continuous concrete buttress, which sloped back to the upper face of the old rubble foundation and was carried back 18 feet within it, the total width of the buttress at its base being 23 feet 2 inches.

Since that portion of the shaft which was already completed with its foundation was 180 feet in height and weighed 35,750 tons, it was obviously necessary to place the concrete buttress section by section, breaking out a certain portion of the old foundation at a time, and building the new work in the space thus prepared for it The new foundation rests on a bearing surface of 16,000 square feet as compared with 6400 square feet for the original

Capt. Woart states that the entire work of underpinning was accomplished without causing the slightest crack or the least opening in any joint of the 180 feet of the existing monument. The new foundation rests upon a bed of fine sand two feet in thickness, below which is a bed of boulders and gravel Borings were made in this deposit for a depth of 18 feet, without passing through it. Work was resumed on the shaft in August, 1880 The first 13 courses, 26 feet, were faced with white marble from Massachusetts. The remainder of the shaft to the top is white Maryland marble, similar to that used in the lower section The new work was backed with dressed New England granite to the 452 foot elevation, above which the walls are entirely of marble of through and through blocks. From the level 470, where the ribs of the pyramidion begin, the courses are secured to each other by mortises and tenons cut in the builds and beds of the stones.

The pyramidion, which is 55 feet high, is supported on 12 marble ribs which spring from the interior face of the walls at the 470-foot level The outside covering slabs are only seven inches in thickness, and they are supported on inwardly inclined marble ribs. The monument as finished, carries a solid capstone which weighs 3300 pounds. This was set in December 6, 1884, and marked the completion of the work.

As finished, the monument is 555 feet 5⅛ inches in height, and its weight is so distributed that, if it were ever subjected to a wind pressure of 100 pounds per square foot, representing a wind velocity of 145 miles per hour it would show a large factor of safety against overturning.

The Monument Society raised by free-will offering the amount of $300,000; the balance of the total sum of $1,187,710, representing the cost of the monument, was provided by the Government.

Draining Land With Gasoline

(*Continued from page 34*)

The wheel excavator is equipped with steel bed frames, securely braced, permitting the mounting of power apparatus thereon Internal-combustion engines, consuming gasoline, kerosene, naphtha, or alcohol, are used, though steam engines and boilers are sometimes preferable. The machine is supported upon two pairs of wheels, the front pair being provided with flanges to avoid slipping sidewise from the line of the ditch. The rear wheels, broad and large, carry the bulk of the weight. Not infrequently, the wheel excavator is fitted with apron or caterpillar tractors instead of rear wheels. Digging is accomplished by buckets upon the rim of a large wheel which is revolved in the trench As each bucket reaches the top of the circle the dirt is dumped upon a conveyor belt, which can be shifted to deposit the upturned earth upon either side of the ditch. Friable soils suggest that these machines be equipped with shields, following close behind the digging unit, keeping the trench open until the tile can be placed

Not unlike the wheel in working principle, the endless chain machine has a steel bedframe upon two pairs of wheels, and upon this base is carried the steam engine and boiler and internal combustion engine Apron tractors are frequently substituted for the rear wheels. The digging unit is driven by means of a sprocket wheel at the upper end of the frame, and receives its power from the engine by means of a chain or belt drive. After terminating their upward movement, the buckets empty their contents upon an endless belt which conveys the soil to a sufficient distance from the trench so as not to roll back on to it. As a precaution against the trench caving before the tile is buried, shields can be attached One manufacturer markets a machine capable of cutting a ditch from 15 to 24 inches wide and any desired depth not exceeding ten feet. This outfit is equipped with tractors and is operated by a 28-horsepower, four-cylinder gasoline engine Its road speed is 1½ miles per hour and its digging capacity is eight to ten feet per minute. This equipment weighs 8½ tons, can be operated by one man, and sells for $6800.

The scraper excavator is merely an adaptation of a machine originally designed for cutting huge ditches. A swinging boom is mounted on the bed of the machine and the bucket or scoop is suspended from a cable running through a sheave at the outer end of the boom. The drag bucket is filled by being drawn toward the base of the boom by means of a second cable Forthwith the bucket containing the material excavated is elevated by the boom line and the boom then swings it to the dumpline If desired, another cable from the hoisting engine may be run over a sheave at the end of the boom to lift the tile into place from beside the trench Steam or gasoline power is capable of accomplishing all the work of digging, swinging and dumping the dirt and of lifting the tile in place The machine costs approximately $5500.

Both horse-drawn and power-operated implements are utilized in back filling the tile trenches. For shallow ditches the practice is to use a moldboard plow, while a V-shaped drag can be employed to advantage. Suited to back filling of large ditches is a power-operated machine which travels along one side of and parallel to the ditch. When the material at a given place has been deposited in the ditch, the machine moves forward and takes up a new station directly opposite the succeeding section to be filled. It has a capacity of seven buckets of soil per minute and is operated by a ten horsepower gasoline engine. The market price is $2000.

The costliness of machinery for laying tile has given an impetus to a movement for community tile drainage wherein the farmers of a particular locality invest in adequate equipment for cooperative use A notable example is the project undertaken in 1917 as a war measure by the New York Food Supply Commission Three traction trenching machines were purchased and during the following year the Commission accepted responsibility for the continuation of the cooperative enterprise, acquiring ten additional machines at a cost of $60,000. One hundred and fifty farms were visited, 40,000 rods of trench were cut and over 12,000 acres were benefited by adequate drainage.

The Four Passenger Phaeton

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SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy — AUGUST 1923 — $4.00 a Year

WHERE FUTURE AIRCRAFT ARE TESTED. INTAKE END OF [illegible] WIND TUNNEL [See page 88]

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With the Editors

ONE of the most pleasing testimonials which we have ever received comes from a member of the National Committee of the Y M C A of China. Let me express again to you,' he writes, 'my appreciation of the great service which you have rendered through all these years in the interest of popular scientific education I find the SCIENTIFIC AMERICAN wherever I go on my many journeys in China, and everywhere it is of great interest to Chinese students who understand English, and to many who don't Personally it has meant much to me from boyhood and through these more than twenty years of popular scientific lecture work in China and many an idea and item from its pages we have carried to the people here in spoken lecture form All of which is just one more indication of the attention paid the SCIENTIFIC AMERICAN, and the influence it carries all over the world As the Briton usually says to explain his persistent reading of our pages "You know we have nothing quite like it here"

FOR next month our informal psychic investigation moves back to America Shortly after their joint return to New York, Sir Arthur Conan Doyle found it possible to arrange for Mr Bird several séances in our own Middle West These sittings were not test ones any more than those which Mr Bird had abroad—they were in fact but an American supplement to his European tour part of it rather than of our formal investigation here In the September issue he tells of a sitting thus held with Miss Ada M Besinnet of Toledo regarded by spiritists as America's foremost medium and already known by name to our readers of as far back as September and December 1922 As usual Mr Bird tells what happened without hazarding any opinion as to causes and we are sure that every reader will agree that plenty happened to make a fascinating story

INCIDENTALLY, we have felt rather keenly the limitation of space in connection with Mr Bird's reports When eight and ten thousand words of rough notes made the morning after a séance or even the same night before retiring while the subject was still fresh in mind—when these are boiled down to four thousand words or so something has to be left out So keen is the interest in this series, so many the letters of comment so voluminous and so interesting the suggestions from readers as to how certain things might have been done and the queries as to whether this that or the other possibility was guarded against that we have decided to get Mr Bird to put these informal séances into a book from which it will not be necessary to omit anything at all that he considers worth putting in This volume will appear during the fall, at a date and under a title that will be duly announced later

WE dislike to promise stories for any definite issue, because whenever we do, some evil fate pursues us and crowds them out Once or twice, indeed, the evil fate has pursued the prospective contributor, with such effect that we never got the story. But we have a lot of interesting features which we can at least promise for early issues. The superpower project, in which the technical world keeps returning, and which comes closer to realization with every such return, is up for attention once more In connection with this story we shall have a handsome drawing of a typical large modern power house showing all the features that contribute to making the wheels go round and the juice flow out over the transmission lines This drawing will go a long way toward giving our readers a better understanding of why it is so economical to manufacture power in the largest possible units

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AUGUST 1923

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Vol. 129, No. 2 Published monthly. Entered as second class matter June 18, 1879 at the post office at New York, N Y, under the Act of March 3 1879
Price 35 cents a copy $4 00 a year Postage prepaid in United States and possessions and Mexico Cuba and Panama; $4 50 a year for Canada Foreign subscriptions, $5 00 a year postage prepaid.

THEN there is a remarkable new development in the rubber field which promises to carry us as far ahead of the cord tire as the cord is ahead of the fabric shoe and to do even more than this for the rubber industry as a whole One of our special writers will cover this Not unrelated is the report which we shall soon have of a long series of impact tests aimed at giving us a better idea of what happens when the tire hits the road. Mr E D Smith will continue his remarkable series of stories showing how the shady side of the community does it his next contribution being on the crooked gambler who plays the cards the wheel, or what not with an artificially big percentage in his favor or with an even more immediate advantage than that Mr L Lodian will favor us with another of his interesting tales of the curious things that the foreigner in our midst eats and that we can buy and sample if we will but explore the little stores of our foreign quarters

PERHAPS a word about this contributor will not be amiss Born in Connecticut he has to use his own language, toured from Manhattan to Mongolia from Italy to India from Iberia to Siberia from Mexico to Manchuria from Hibernia to Hawaii from Switzerland to Ceylon and Singapore from the Pacific overland to Poland and Paris from New Zealand to Nippon from the Pyrenees to the Plata from the Andes to the Alps —and we expect that we rather than he are responsible for the stopping at this point of his alliterative wanderings He has traveled close to the ground and close to the people He gets extreme pleasure nowadays in sallying forth from his metropolitan dwelling place and exploring the marts of New York's exotic colonies in search of the things that he has learned to eat five thousand miles away When he has collected a sufficiency of samples he brings them in and has our staff photographer pose them and then goes home and prepares a manuscript describing them Sometimes we wish we could be as enthusiastic about their odors as Mr Lodian is about their flavors—but that is doubtless too much to ask

THE electrical statistics upon which we based the graphic statement of page 371 in our June issue were borrowed from the *Electrical World* which got them together at no little cost in time and real money Our indebtedness to this contemporary should have been acknowledged and our failure to give this acknowledgment was due to oversight, which we now make good.

AND here we are at the bottom of the second column and no space left to puff out our chest and brag a little about the current issue As usual we feel that it is the best yet and we hope all the rest of you will feel just the same way about it

Another 250,000 "Miler"

After delivering more than 75,000 miles of service to the city of Auburn, New York, this Model "D" 1911 Franklin, illustrated below, furnished Arthur Maddocks more than 175,000 miles of service without replacement of a single Timken Bearing. A total of 250,000 miles.

120,000 miles of these quarter million miles of service were delivered in and around the mountains of Colorado.

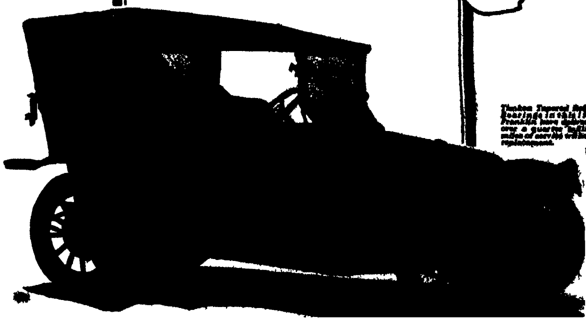
On the 28th day of April, 1923, Mr. Maddocks furnished the following affidavit made in Denver:

"During all the time I have had the car, which is from April 1, 1913 to date, the Timken Bearings were not replaced until April 22, 1923; and the Timken Bearings delivered to a representative of the Timken Roller Bearing Service and Sales Company are the same identical Timken Bearings that were in the car on the date purchased by me, and I have every reason to believe are the original bearings put in the car. From the present condition of the bearings in question, I believe they would easily last the life of the automobile, which is at this time in first class shape and which, during the next thirty days, will be converted into a service car to be used for towing."

Twelve years of service showing more than 250,000 miles without one single Timken replacement.

The Timken Roller Bearing Co
CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS



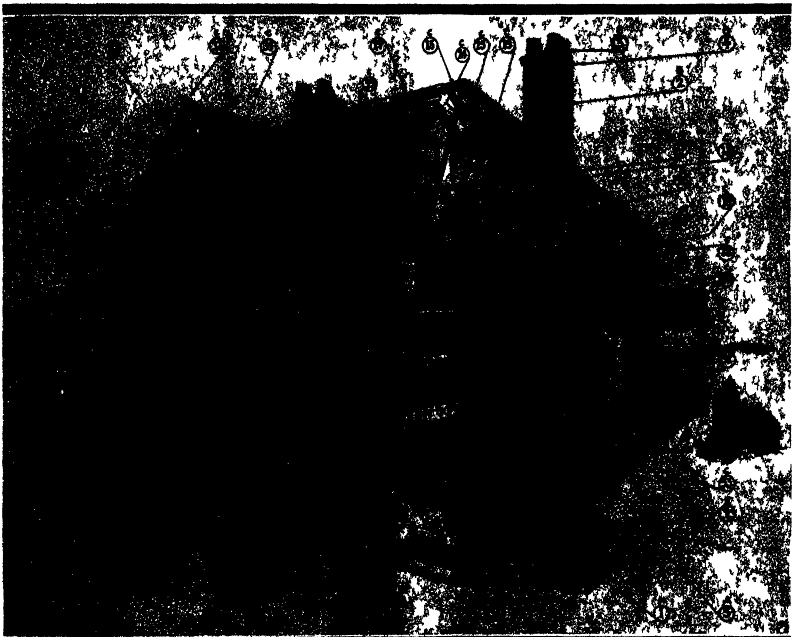
Timken Tapered Roller Bearings in this 1911 Franklin have delivered over a quarter million miles of service without replacement.

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, AUGUST 1923



A— [illegible]

B— [illegible] Wall

1— [illegible]

2— [illegible] Pots

3— [illegible] Cap

4— [illegible]

5— [illegible] Door

6— [illegible]

CARPENTER WORK

C— 1—Iron Columns

2—Column Cap

3—Column Base

4—Coal Bin

5—Girder

6—First Floor Beams

7— [illegible]

8—Flooring Paper

9—Under [illegible] Floor

10—Top (or Finish) Floor

11—Second Floo[r] [illegible]

12— [illegible] Attic Floor [illegible]

13— [illegible]

14— [illegible] Beams

15— [illegible] Rafter

16— [illegible]

17— [illegible] Board

18— [illegible] Post

19— [illegible]

20— [illegible]

21— [illegible] Head

22—Rough Sill

23—Truss over opening

24—Rafter

25—Hip Rafter

26— [illegible] Rafters

27— [illegible] Lath

28—Diagonal Sheathing

29—Sheathing Paper

30— [illegible]

31— [illegible] Board

32— [illegible]

33— [illegible] Cornice

34— [illegible] End

35—Valley

36— [illegible] Corn[i]ce

37—Second Story Wa[l]l

38—French Window

39 Porch Co[r]n[ic]e

40 Porch Column

41—Pilaster

42—Dormer Window

43—Leade[r] Head and Leader or Downspou[t])

44—Gutter

45—Balustrade

46—Sta[i]r Soffit

47 S[li]d[i]ng Doo[r]s

48—Wainscot[i]ng

49—Casemen[t] W[i]ndow

50—Platform

51—Deck Roof Ba[l]cony

52—V[e]randa Balust[r]ade

53 La[tti]ce

54 D[u]tch Doo[r]

D [illegible]

E— —Grade

F Dra[i]n

[illegible] of a properly constructed brick and frame residence with the commonly used terms (see page 89)

Invention and the "Grifter"

Gathering in the Foolish Dimes and the Heedless Dollars at the Summer Amusement Parks

By Edward H. Smith

THE other Sunday at Coney Island some of us witnessed a sad example of the justly famed pitiful spectacle A very brilliantly attired young man and his Paradisian sweetheart were plumb-bobbing That is to say, they were standing before the booth of a concessionaire in tinsel dolls and perilous candy, swinging a bowling ball, suspended from the roof of the little kiosk by a chain, in a vain effort to knock down two fat ten pins which stood on the counter in what seemed to be the easiest range of the pendulous ball.

"The thing's as easy as pie—as soft as syrup!" cried the barker insistently

The bravely dressed young man paid his dime, pulled back the ball and let it go Surely it would fly back in the direct projection of the pendulum and knock down the two pins, thereby winning the doll or the candy But it didn't It swung out, turned and flew back in ellipse, just wide enough to miss both pins.

"Pretty close, friend pretty close that time," sang the leatherlung "Better try it again See me do it! Just swing the ball right past this right pin here, like this, and—bingo! Down they go, every time. It's all a matter of skill."

The concessionaire or grifter, to give him his native name, had indeed let the ball go just past the shoulder of the pin on the right and again it had travelled an ellipse, but so narrow that it touched the left pin as it swung back and sent both of them toppling down

"Try again, friend!" barked the impresario blithely, setting up the pins with a meticulous care that escaped his customer's attention

The young man did try and failed. He tried again, growing redder and angrier as he saw the circling ball swish harmlessly past the pins once more

His bedizened young lady was full of enthusiasm and excitement

"Let me do it, let me!" she urged, and the grifter gallantly indicated to his sputtering customer that this was the proper maneuver

She tripped on her spindle heeled, carmine shoes and took hold of the heavy ball After a good deal of giggling and simpering she aimed her shot. The ellipse was almost a circle

"No, no, no, Miss!" complained the grifter in earnest imitation of torture "You mustn't swing it wide You must cut just pahst the shouldah of the pin heah Let me help you"

None but a practiced eye would have noticed him pick up the right pin, give it a half turn in his hand and then set it down again very carefully on the spot Guiding the young woman's shot he let her send the ball flying past the pin by a hair's breadth It swung away, stopped and swung almost directly back in the true pendular course Straight between the two pins it plunged and down they went to the amusement of the crowd, the intense delight of the young thing and the black disgust of the young man.

Needless to say the grifter immediately handed over a tinselled doll of the girl's selection and invited her to try again She looked for encouragement to the young man and then did risk half a dozen more shots. But now, alas, she could not win Her escort, still angry over his own failure and discomfited by her single success, took the ball and began to shoot again He missed thrice and went away fuming, having paid about two dollars for a doll worth forty cents.

The call of the blithe entrepreneur of summer amusement followed him down the walk:

"Step right up, ladies and gentlemen All a matter of skill, friends. All skill Just a game of skill!"

But was it? And when the millions rush to the summer parks, the sea shore, the picnics, the street carnivals and wherever grifters and their alluring games are appearing this summer, will it be a mere lack of skill that will send some millions of good money into the pockets of these sad rascals? It wasn't in the case of the man with his ball and ten pins. That right pin had been carefully slanted off on the bottom, so that when he set it up for the trade it leaned away from its fellow perhaps half an inch at the top. That was sufficient to send the ball into an ellipse wide enough to miss invariably But when he wanted some one to win, in order to encourage further play, he merely turned the pin half around so that it now leaned a full inch nearer its mate. Now the ball sent just past the in-leaning pin came almost directly back and winning was unavoidable

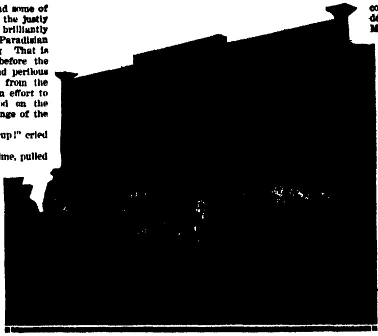
A trick of this sort is called a gimmick or gouge—and that term is the Aladdin's ring that gives us sesame *into the land of summer folly, of grifters, concessions,* games, rides, hot dogs and ballyhoo.

One seldom stops to think of it, but a very large company of skilful inventors is constantly busy devising for the summer parks and street fairs. Many of these men are geniuses of no common order. The chute-the-chutes, the figure 8, the great scenic railways, the various gravity rides, the cyclorama, the airplane machines, the mechanism of the whirling houses, the witching waves and a hundred other "rides," from the humble carousel or merry-go-round to the most complicated modern thriller, all are the fruit of real inventive power and some contain prodigious ingenuity. Such inventors as S. F. Jackman, originator of the gravity rides; W F Mangels, of carousel fame; H. E. Riehl, of the whip and other devices, Thompson & Dundy, who developed Luna Park, and the Chesters, inventors of the balloon race games—these men and others like them were dowered with imagination and the power of originating and applying ideas. Riehl it was, by the way, who built Luna Park for Thompson & Dundy Beginning with the Chicago World's Fair in 1893, when the first of these big pleasure machines appeared in the shape of the Ferris Wheel and the Chute the Chutes, and coming down to date, such inventors have set up their strange machines all over the country, in parks and grounds dedicated to the kind of joy these inventors made popular

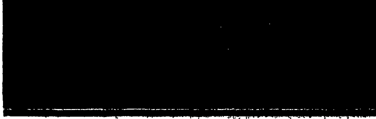
It is not of such men, or of their legitimate, high-grade amusements that I speak But there is another, stranger and more interesting inventive genius whose dark and devious devising are part of that form of hilarious madness which comes with hot days and escapades in the parks. These men, for the most part, belong to the half-world of showland They are the workers, grifters, showkeepers or, to be polite, concessionaires and to a very large extent they still devise their own games or adapt them from older rackets. But not so extensively as of old is the grifter his own inventor Today there are numbers of manufacturers who cater to the summer amusement or carnival trade and they frankly manufacture all the games and devices known to this romantic world. They make them "square" or "strong," as the customer desires. "Square joint" is the grifter's vernacular for a booth where the customer gets fair play, "strong joint" the opposite These manufacturers keep numbers of inventors at work, year in and year out, making new tricks for the old trade, for the public is ever finding out the secret of some game or coming to suspect it Therefore, it is necessary to keep men busy varying or innovating.

Most of my readers certainly will have wondered on many a colorful day in past summers, why they could not win at some of these park concessions while the man next to them had consecutively good luck or why they lost at games of skill while some frail girl stepped up and took the prizes they had been aiming at. To understand these phenomena, it is necessary to see how the summer park grifter or faker works. In the older day the grifter always worked with an assistant or shillaber and he still does this in many instances. The shillaber both encourages "suckers" to play by word of mouth and lures them into the trap by posing as an outsider and winning consecutively. Again, many forms of amusement games are so controlled or gimmicked that the grifter, without any need of a shillaber, can let win whom he likes. An occasional winner is the best advertisement and the wily grifter usually chooses a woman as the recipient of his beneficence. So——

If you happen to be playing a game without success and some man steps up, plays successfully each time and walks off with a half dozen prizes, you may be sure he is a shillaber, who will return in good time with the goods. Often a local simpleton is hired to play this part, then



Typical balloon blowing game. The rubber balloon here is in the throat of a frog; it expands as the customer plies a lever, and the winning frog is the one that croaks first. But—the game keeper usually has mechanical control that enables him to make any given frog win



Plum bobbing; an officer inspecting the outfit to see whether it is really a game of skill as represented. The object is to drop both pins with one swing of the ball

which fact comes the very old notion that hunchbacks and halfwits are lucky They have been carried about by the mountebanks of many centuries and always allowed to win, so that the gulled crowd might be tempted to play and lose its cash. On the other hand, if the woman beside you suddenly wins with her first or second play and dashes off with some flashy prize, you may be sure the grifter has thrown the game her way both to encourage play among the onlookers and to send her wandering about the park with her eye-filling award, thereby advertising the grifter's game

Perhaps you have yourself stepped up to one of these games where several were playing, and won substantially at the first venture. If you will note carefully you will discover that this doesn't happen unless there is a crowd behind you Your good fortune is the lure by which the others are coaxed on to fill

Poker with darts—try to get four aces if you can

But perhaps the simplest way to make the whole business clear is to take up a few of the representative summer park and carnival games and explain how they are gimmicked Let us begin with the old and ever popular hoopla This is the generic term for all forms of games where the aim is to throw a ring or hoop over an object to be won or a base on which this object rests to which it may be attached The old cane rack is a good example The oldest and crudest gimmick used on the cane or umbrella rack was to have the rings a trifle too small to go over the heads of any but the tawdriest and cheapest articles However the grifter always had in hand a few rings which were larger but not perceptibly so, seen with the naked eye at a little distance When the crowd became restive at repeated losses or poor winnings, the shillaber now commonly called shill, stepped up and was of course given some of the larger rings He immediately won the finest cane or umbrella in the rack laughed raucously at the mock discomfited grifter and strolled away with his prize The crowd, of course surged forward to take advantage of a "turn in the luck" But the gentleman behind the counter wasn't passing out any larger rings just then

Some hoopla games belong to the order known as "flash and slum joints" In the language of the valiant summer showman "flash means the big showy prizes offered at various booths Slum on the other hand refers to the worthless small wares Thus in the Japanese rollball game to be seen along every board walk in the land, the big showy pieces of Satsuma the expensive sets and large vases are "the flash" The little match trays and ash receivers are the slum In this game as in all others no one wins the "flash without paying from three to fifty times its value However, in these roll ball games the big pieces can be won if one has patience and money enough to stick to it

In the "flash and slum' hoopla booths, on the other hand, the big prizes are never won by any but the shillabers. Watches are much used in these places and the cleverest grifters use fine American movements in solid gold or even platinum cases, watches worth up to two hundred dollars But on the rack with one or two of these fine timepieces are many cheap watches, brass magnum stickpins and the like. This game is gimmicked in one of two ways Either the base under the desirable watch is a little too large for any of the rings to encircle or there are only a few rings large enough to do the trick In the former case nothing but the slum is won in the latter only a shillaber is allowed rings large enough to do the trick You pays yer money and you takes yer medicine

There is always about all carnivals parks and street fairs the kind of man known to the inner circles as a half wise boob one who can most easily be duped because he has that little knowledge that is so dangerous For the humiliation of this kind of man the grifter has various mechanisms containing a double gimmick The wisenheimer is acquainted with the first but not the second

Some years ago I was standing in a Chicago amusement park when a young man of the know it all character strolled up to a booth where a well known grifter was conducting a little trick pool game The game keeper tried to interest this youth in his sport but met with the swaggering answer

'Wotcha tryin ta do? Kid me? I'm wise bo

All right son said the grifter and immediately pulled out a curiously designed knife He opened the blade and began carving a bit of wood

The egotist's eyes followed the knife In a moment he had made some comment about it

Betcha a quarter you can't close it said the grifter instantly

The young man's breast swelled with injured dignity

The —— I can't ' he snapped

The bet was made and the knife handed over Try as he would he could not close down the blade He could not budge it from its seat without destroying it

The grifter laughed loudly pocketed the wise young man's money and benignantly showed his new friend the gimmick, an obvious enough little catch which kept the blade from being closed down The sucker was delighted, tried the catch three or four times until he felt sure he understood it and then offered to buy the knife The grifter, of course, refused to sell

At this moment a stranger came wandering along and stopped to gape at the pool game like any countryman The sucker who still had the knife in his hand, as per arrangement, immediately attracted the intruder's attention and offered to bet he couldn't close it Again a twenty five cent wager was posted and the stranger lost The gimmick was shown him and he too, studied the thing carefully Suddenly he said to the wise young man using a rustic speech

Aw this is easy I bet I kin close it an you can't open it

The wise young man of course received such a proposition with derision

'How much ll you bet? he demanded

'Fifty dollars

The grifter seeing from the wisenheimer's attitude that he didn't have that much, nudged him and whisperingly inquired how much he was short

I only got forty said the dupe

Bet him urged the grifter under his voice "I'll take the other ten

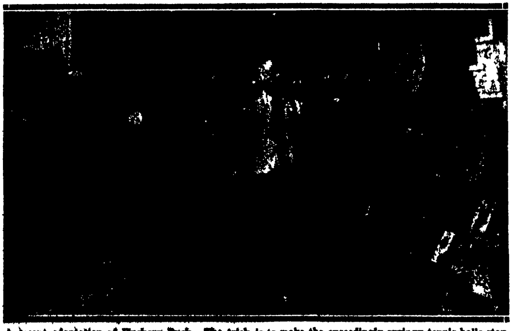
So the bet was made the newcomer closed the knife, the grifter held the stake and the clever young dupe tried to open the blade He tried till he was blue in the face and couldn't stir it Then the grifter regretfully paid the bet to the stranger who went his way rejoicing

Durn it said the grifter when the other man had gone That guy knew more'n I did. I didn't think there was a double gimmick on that knife

The stranger needless to say had been the grifter's shillaber

Such ingenious little instruments of fraud are being invented and manufactured constantly and discarded in favor of newer ones as they become too widely known

For many years as you have walked into parks and street fairs your eye has been caught by the man with the series of little tin cans buckets or tubs or the triangle of little wooden barrels The trick is to make three balls tossed into these receptacles at short range stay there All of us have tried it again and again It looks extravagantly simple but the balls always bounce out again Let one toss them ever so gently out they pop and the prize is lost But the fellow next to us makes them stick How come?



A recent adaptation of Huckery Buck. The trick is to make the exceedingly springy tennis balls stay in the bucket. This time there is no cheat—except that it is just naturally so hard to do that you more than pay for any prize you win

This game is called Huckery Buck or Huckely Buck, depending on whether one talks to an Eastern or Western grifter and it is managed in a hundred fashions. It is one of the classics of parkland Of course it is gimmicked Last summer at one of the principal parks I saw a mellow old grifter a man who had come through all the imaginable splendors and vicissitudes of life with a faint sad smile playing live chickens or ducks against the dimes of the innocents No one won till I stepped up under the arm of a famous old outdoor gymnast The grifter recognized us instantly and invited us to play My friend did so at once and soon won four ducks

Keep em for me till I come by will you?" he asked

Surest thing old man," said the grifter without the

(Continued on page 155)

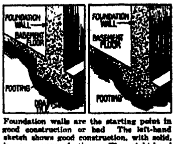
Camouflage and Carpentry

How the Housing Shortage Has Played Into the Open Hand of the Jerry-Builder

By A. G. Ingalls

DURING the past spring there has been such a boom in housebuilding as the American nation has never known. The war brought in its wake a shortage of 1,000,000 dwellings, and the effort to catch up with the consequent demand for homes has brought about a peculiar and unhealthy situation in the house-building industry Good houses are being built—and bad. It is of the latter class and how to avoid them that this article has mostly to do.

Thousands of houses are being put up by speculative builders, a large portion of whom are doing good, honest work. But the remainder are being built hurriedly carelessly and cheaply In some cases the builder, after he has received his payment, does not care how shabby a house will get to look. The worst feature of it is that, to the eye of the average person who is not familiar with the building industry, the products of the good and of the bad builders may not appear to differ in quality, to any marked degree, and the would-be purchaser has the greatest difficulty in unshuffling the bad from the good For by the very nature of a house it is unnecessary purposely to camouflage bad work The walls, when completed, conceal it.



Foundation walls are the starting point in good construction or bad The left-hand sketch shows good construction, with solid, large, square footing The right-hand sketch shows poor construction, with insufficient and wedge-shaped footing which is bound to sink under the building's weight

A study in foundations

Thus it frequently happens that the home-hunter falls to the wiles of the real estate salesman who, in painting an entrancing picture of the joys and advantages of owning one's own home, knows only too well that his depiction meets with its long-since-established counterpart in the mind of the prospective purchaser—and his wife. The pretty little house is bought on the plan of "a little cash and what you now pay in rent," but because it is not properly built in the beginning, long before the final payment has been made it will have become a shabby, sagging structure with little resale value

Admittedly, it is very difficult for the average person to ascertain whether the house the speculative builder has erected and is trying to sell to him after completion, is sound, or whether it is "jerry-built " Buying a house under such circumstances is, in part, at least, a gamble It is like swapping jack-knives "unsight and unseen," a grab-bag affair in which the most essential parts of the house—the inner structure—are pretty well concealed by the finish With his knowledge of house-building the trained architect, the disinterested housebuilder, or even a good carpenter can penetrate beneath the camouflage. But to the person who has not been familiar with the building industry, and that quite recently, the purchase of a house is fraught with innumerable pitfalls because there are a thousand and one details of construction principles that are seldom apparent, especially under the intriguing glamor of new paint, bright varnish and white tile.

But the man who is already familiar with the game will refuse to be thus intrigued. Nor will his eye so long rest on the fact of an attractive sunporch, a warmth-inviting fireplace, hardwood floors and a modern kitchen, as on the real structure of the house. He sees not only the finished product but the method of making that product His mind runs to stresses and his eye hunts for strains. When he looks over his prospective dwelling, he has in his mind some such picture of the elements of a house as our artist presents on page 77 of this issue. He knows what to look for, and where to look for it

Such a man, in company with the prospective home owner, will soon look a house over, and if it happens to be poorly built, he will be able to paint a word picture of what it will look like in eight or ten years when the walls have settled, with doors and windows continually sticking, the plaster is cracked and the roof has become swaybacked. The enticing newness will then have vanished, but the repair bills will have mounted higher and higher Keeping up the periodical payments on such a house will have become a matter of "paying for dead horses."

The salesman who is interested in disposing of what he knows to be a jerry-built house usually devotes his best efforts to gaining the approval of the wife of the prospective buyer and he is only too glad to have her come with her husband to look it over He does not do this so much because he thinks she will be a poorer judge of the construction details, but because he knows she is the more apt of the two to succumb to its undeniable attractive features and its cleanly painted outwardness. The tiled bathroom, the little kitchen so attractive and modern, the cosy fireplace, the varnished hardwood floors, the tasty outside trim and the leader pipes of copper are apt to loom higher in the estimation of a woman than of a man. True, the tiles of the bathroom may be poorly set, so that they will soon allow water to leak down on the ceiling below, the fireplace may prove smoky because it lacks a properly designed fireshelf in its flue, the hardwood floors may be very thin and may have no sub-flooring at all, while the shining varnish may be for inspection purposes alone, peeling and wearing off before the home is a month old. The addition of a few copper leader pipes, of themselves excellent features, costs the builder comparatively little and adds very much to the "blow-of the-eye" value in giving a mis-estimate of the real worth of the structure The salesman knows that if he succeeds in making a strong impression on the wife, she will work continually to overcome the objections of the husband and may finally succeed in wearing them down and out.

GIVEN honest intentions we can build altogether better houses today than have ever been built. But we do not always do it. The demand for a million homes has brought the speculative builder into his own and as the price of materials and the cost of labor have gone up, the quality of materials and workmanship have gone down Within ten years a large number of the American people are due to discover that their jerry-built homes are in process of rapid dissolution. It will be almost too late to mend Yet those who today will give particular attention to the structural fitness of the house they are being urged to buy rather than its superficial appearance and modern equipment will feel that their insistence on knowing what they are paying good money for has amply repaid itself What to look for in a house and how to look for it—that is the burden of Mr. Ingalls' article, and of the drawing on page 77.—THE EDITOR.

The temptation of the builder to pare down costs to the detriment of a house, begins with the foundation. The foundation wall should have a proper footing, for of itself it is not broad enough to spread the weight over enough earth to prevent settling. Only in case the wall begins on solid rock, or in the case of a light structure such as a one-story bungalow, may the footing be omitted. Otherwise, settling is practically sure to follow—and settling brings a whole train of troubles in its wake, for it distorts the house. This causes the doors and windows to stick, refusing to close, and the plaster to crack. The floors are warped out of their original geometrically perfect form and will spring and creak under the feet. Spaces will develop between the floors and baseboards, as well as between the woodwork joints. The roof may become so distorted that it will leak. Even some of the plumbing may be disrupted.

Bearing posts are of prime importance if a house is to remain true [illegible] properly, and walls [illegible] omitted. The left-hand sketch [illegible] bearing post [illegible] right-hand sketch [illegible]

Good and bad cellar posts

Yet in many cases, in order to save their costs, the necessary foundation-wall footings have been omitted entirely. Since the base of the wall is soon covered on the outside by a little earth judiciously pushed in by the jerry-builder, and the cellar floor is quickly grouted in, this is a rather difficult thing to make sure of.

The footing should be at least 16 inches in width and ought to be six inches in height. In most cases it is made of poured concrete and this should have enough cement in its content so that it cannot, at least, be kicked to pieces with the shoe, an act which was easily committed by the writer on the footing of a house being put up by a speculative builder of the too-greedy sort. The outline of form for the footing is generally made by cutting out a small trench of the shape desired and filling it in with the concrete mixture. But it is highly important that this trench, which is to give final shape to the footing, should be carried out flat and square to its edges. For if it is a rounded trench, the footing, instead of being flat, will have a semi-circular, almost wedge-shaped cross-section and will not be able to carry half the load that may be placed upon the perfectly flat base.

The cellar floor is generally made of concrete and should be made up of at least six inches of cinders followed by three inches of concrete and an inch top-course of cement mortar But many houses are being built in which the cellar floor consists of no more than two inches of cinders covered by a very thin buttering of cement mortar Since such a thin layer of concrete is certain to be broken by the rough handling of ash-cans, the cellar floor should be sounded or tested with some heavy object such as the butt end of a piece of timber. Cellar floors have been observed that could easily be picked to pieces with an umbrella.

Usually there is a girder across the cellar and its function is to support the inner ends of the joists as well as the weight of the partitions above it. These in turn carry the inner ends of the second story joists, together with the lath, plaster and other heavy details. The support of this girder is highly important. If the span is long, a pier or column should support its center; and just as important, that support must have a broad footing, not merely on top of the concrete floor, nor on a small chunk of concrete which has been poured into a shovel-hole in the earth, but on a "duck's foot" at least sixteen inches square on a flat bottom. If one end of the girder happens to come opposite the main chimney, it most certainly must not have support in the latter beneath the fireplace. Otherwise, a fire will eventually be the result.

If the cellar wall is made of hollow blocks a searching investigation of the mortar should be made with a jack-knife. In some jerry-built houses now being sold, the mortar used in the foundation walls is little better than mud and may be picked out quite easily However, if the wall is made of monolithic concrete it will do no harm to be suspicious of a kind of "veneer" construction which has become fashionable among contractors of the sort who wish to make the most of a job financially, at the expense of good work. In this case the inside and the outside of the wall are of quite good concrete but they are only shells. Careful inspection will reveal some weak spot in this shell into which a short lever may be inserted to pry off whole slabs of the wall. But an honestly built wall of solid concrete without [illegible] filling should withstand any battering that the interested person can bring against it with the end of a timber.

Such a veneer wall will often be shown up by the formation of [illegible] bulges or swellings on the face directly under the point where the girder bears heavily on top of the wall. These are caused by the buckling of the veneer under the great weight of the wall [illegible].

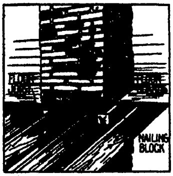
Many builders have gradually [illegible] the habit of economizing on the [illegible] of the [illegible] and this may [illegible] put up [illegible] be [illegible]

feet, they should be 2 by 10 inches, not 2 by 8. The decrease in strength brought about by the use of the smaller joist is disproportionate to the respective sizes of timber. Roughly, the eight-inch joist is but two-thirds as rigid as the ten-inch size.

The joists in a solidly built house will generally be spaced 12 inches apart from center to center, although there are places where an increase of two or three inches is allowable. But because there is so acute a shortage of houses and almost any house will sell, houses are being built and sold today in which the floor joists are spaced 18 inches apart and are of but eight-inch stuff This makes a nonrigid floor which will soon creak and will tremble under every impact

The cross-bridging between the joists is the series of small pieces forming crosses These pieces do not need to be more than an inch thick, but the main thing is to see that they are provided and that none are missing. Trifling as they look, their omission renders a floor far less rigid against localized shocks and loads Their function is only secondarily to hold the joists in place. They are for stiffening the floor Imagine a sudden load applied directly over a single joist That joist springs down. But the motion is carried through the bridging pieces, sidewise and downward to the joists on either side. The stress has thus been distributed over three, not merely one, joist But as the outside pair go down they in turn transfer the motion through their own bridging pieces to their neighbors—and so on to all the joists of the room The omission or careless placing of a single piece breaks the chain and the floor trembles unduly

One very common fault of the cheaply built house is caused by supporting some of the framework directly on the fireplace chimney To this there are two objections. A fire may result; and there will be settling around the chimney In any house the big fireplace chimney is very heavy, and no matter how good its footing it is apt to settle to some extent Any portions of a house which are attached to it in a manner so that they are dependent on it for support, will also settle, in fact they will help cause the settling However, many houses are being built in which this cardinal sin is being committed, for it renders construction a little less expensive and falls in with the policy of the jerry-builder to pare down the quality of little things here and there from cellar to ridgeboard, making up a total saving that feels good in the pocket The fireplace should be a separate entity from the house, attached to it only for the purpose of keeping out the elements These attachments are comparatively light, thus permitting the chimney to settle without pulling the framework of the house along with it



A chimney running through the center of a house is always a great temptation to the irresponsible builder Floor joists are only too often rested on the chimney and nailing blocks on the chimney serve to hold the flooring A chimney should always be free of such burdens because it has enough weight of itself to support. This point is very important

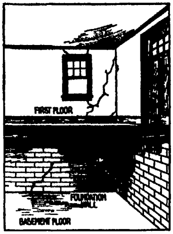
Putting the burden on the chimney

Fireplaces are always built into the speculative house because nothing so greatly adds to the "I want it" feeling of the prospective home owner as the presence of a hearth. But some of these houses have no fireshelf in the flue—a saving in mason work on the part of the builder made in a place where inspection is quite difficult. The purpose of the fireshelf is to control the currents of air and hot gases in such a manner that there will be a good draft A properly constructed fireplace flue, when viewed from below is seen to converge not only at the sides but at the rear—that is, the rear wall tips forward until the throat is but four or five inches from rear to front This constriction, providing it is not so great that the cross-sectional area at this point is less than one-tenth the area of the main fireplace opening, does not hamper the draft, but improves it. The broad ledge formed by bringing the rear wall forward is called the fireshelf. It [illegible] the ever-present downdraft of cold air from the outside away from the fire and upward again.

A deep fireplace should make the buyer suspicious that the fireshelf has been omitted, the idea of the deep opening being to overcome the consequent tendency to [illegible]—a thing it will fail to accomplish A deep fireplace also prevents the heat from getting out into the room where it is wanted, but a properly built throat will so perfectly control the smoke-causing downdraft that the fireplace will draw strongly without smoking when the opening is very shallow

Many of the houses that are now being built have partitions which one could "throw a cat through" These are [illegible] in several ways, in all of which the intention is to cheapen the cost of construction by saving labor, as well as to provide a partition that will survive the sale of the house All sorts of substitutes for sound partitions are being employed and in many cases their weight is being carried on but a single floorjoist Where plaster is applied to plasterboard on such poorly supported partitions it is quite sure to crack along the outlines of the individual sections

Some of the substitutes which are being employed to take the place of sheathing on the outside of the house are very faulty The chief purpose of sheathing is to give rigidness against stresses in a diagonal direction But there can be little rigidness in a diagonal direction if wooden lath applied to heavy paper are nailed against the studs and stucco is applied to the lath Here it becomes a case of the stucco bracing the house against diagonal stresses—a thing it should not be expected to do—instead of the house holding up the stucco as should be the case The stucco will however in most cases remain uncracked until the house has been sold by the speculative builder



Always be suspicious of diagonal cracks in walls no matter how new or how well built a home may appear Cracked walls indicate settling foundations settling or weakened or rotted bearing posts or the use of insufficient framework and undersized lumber Great care should be given to the examination of foundation walls

The meaning of cracked walls

Nothing will give a house as depreciated a look as a sagging or swayback roof However houses are now being built and sold whose roofs are bound to present a very sad appearance within a short period of years because the rafters are too light too widely spaced and in certain cases are not even tied together either by the attic floor joists or by collar beams When the weight of such a roof is exerted downward especially under a heavy snowfall the outer or lower ends of the rafters are pushed apart But if they have been properly spiked to the ends of the floor joists this force cannot have any deforming effect on the roof and the roof will not sag nor will the walls of the house be spread apart This is another one of the structural details which a salesman will not be so apt to dwell upon as the less definite aspects of the general attractiveness and inner convenience The builder who insists upon saving a few dollars is to blame—and he knows full well the effect of such workmanship The carpenter also knows but he must follow plans But he knows wh will have the say about planning and building his own home

Since the price of lumber has so greatly increased many new materials have come into the market but it would be shortsighted to condemn them all simply because they are different They must be judged on their individual merits. In order to be good a house does not have to be built in the "good old way" Expanded metal laths are new—but they have made good Walls which are built up by various processes involving the spraying, casting or plastering of mortar on to fabrics or woven wire are not intrinsically bad But if the house settles some of these partitions are bound to crack badly for they are quite inelastic

Here is what good construction means with regard to floors and inside walls Note the heavy joists connected by bridging which makes for rigidity and distributes weight evenly Then there is the sub-floor laid diagonally Next the building paper which keeps cold air and dust from working up through the floor from the cellar Finally the flooring proper Note too the wall construction

Honestly-built floors and walls

This brings us to the oft heard statement that "they don't build houses as well as they used to" This is a very equivocal statement, but when it carries the feeling that good housebuilding is a lost art it is erroneous, for we can build better houses today than have ever been built In the "good old days" timber was cheap and the lavish use of it was not so much a virtue as a result of the scarcity of sawmills to cut it into pieces of the smallest adequate size. The early builders had a way of making their houses far too strong in some places and altogether weak in others The strength of a building cannot be wholly judged by the size of its frame timbers but a knowledge of structural engineering is necessary in order consistently to apportion the size of the timber to the stresses The strength, for instance, of a two-by four scantling provided the load is kept directly above its long axis, is surprisingly great And a single nail in the correct place will hold more than several in the wrong place

The old fashioned floor joist was about four inches by five This gives a cross-sectional area of 20 square inches But a joist of modern shape and having an equal cross-section would be sawed out in the form of a two-by ten and would, owing to the greater depth of the wood in a vertical direction, have more than twice the strength of the other.

The old time builders knew little about adequate protection against winter cold Building paper was not used A house with which the writer is well acquainted was built in 1856, by a builder for his own occupancy Yet its walls have neither sheathing nor building paper Between the habitants and below-zero weather was only the wall paper, lath and plaster and plain clapboarding whose joints cannot be kept tight The difference is evident in the coal bills.

A Readable Series of Monographs on the Departments of the Government

PRESIDENT TAFT said 'Never has this vast organization (the United States Government) been studied in detail as one piece of administrative mechanism in such a way as to present a clear picture of what the Government is doing To lay the basis for such a comprehensive study the Institute of Government Research has undertaken the preparation of a series of monographs giving a description of each of the fifty or more services of the Government The Institute of Government Research is not a part of the Government in any sense but is an association of citizens who are interested in the promotion of efficiency and economy in its operation There has been cooperation however, between the Institute and the Government for the reason that the personnel of the Institute includes people whose names inspire confidence in the opinions rendered Among its trustees are William H Taft, Herbert Hoover both acting wholly in their individual rather than governmental capacities, George Eastman Arthur T Hadley and A Lawrence Lowell

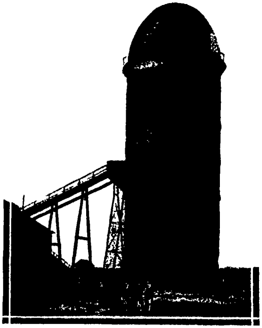
The monographs each dealing with a different branch or bureau are all prepared according to a uniform plan are written in plain language and are readable rather than dry They give the history of the service its functions its organization the character of its plant the laws regulating its operation its financial condition and a complete bibliography of sources of information bearing on the particular service under discussion 'To the public" states the Institute these monographs will give that knowledge of the organization and operations of their Government which must be had if an enlightened public opinion is to be brought to bear upon the conduct of governmental affairs"

Monographs dealing with the Geological Survey the Reclamation Service the Bureau of Mines the Alaskan Engineering Commission the Tariff Commission the Federal Board for Vocational Education the Federal Trade Commission the Steamboat Inspection Service the National Parks Service the Public Health Service the Weather Bureau and the Employees's Compensation Commission have been prepared and may be purchased from the Johns Hopkins Press Baltimore

The Paper of the Future

Means, Ready to Hand, for Staving Off the Impending Famine in this Essential Material

By S. G. Roberts



A monument to waste—the trash burner at a southern yellow-pine sawmill

OUR DAILY newspapers and our printing presses generally are using up annually a vast amount of paper stock which fundamentally draws its raw material from timberlands. The public at large gives little heed to the significance of this drain—the citizenry is concerned only in getting enough reading matter to satisfy its more or less avid demand for news, information and entertainment.

Two years ago we employed in the manufacture of paper more than 6,100,000 cords of pulpwood, and the point to be kept in mind is that the rate of this consumption of the available stands of timber is steadily climbing higher and higher. Both the authorities of the United States Department of Agriculture and the officials of the American Paper and Pulp Association have studied the situation with no small measure of alarm, recognizing how many industries rely, either directly or indirectly, upon an abundance of pulpwood, wood pulp, and the finished paper made therefrom.

The American Paper and Pulp Association emphasized a short while ago that we have become increasingly dependent upon foreign forests in the last seventeen years for a big share of the wood pulp used by our paper mills, and this despite the augmented utilization of domestic wood. It seems that of the total consumption here of pulp in 1920, fully 35 per cent was imported pulpwood and wood pulp. In addition, we obtained during the same year from foreign sources 730,000 tons of newsprint valued, with other alien paper supplies of relatively small amounts, at $85,000,000.

The association declares "The cut-over forest lands of the eastern United States, under proper management, could be made to produce the needed wood. Delay in this project will pile up the eventual cost." This wide-awake organization pertinently asks "Why not begin now?" The purpose of this article is to reveal some of the promising work that has been done in this direction and to show how an apparent waste can be turned into a gain of great economic moment.

At the present time, the manufacture of the wood pulp is, for the most part, concentrated in the New England, the Middle Atlantic, and the Great Lakes States, where formerly there were abundant local stands of spruce. Now, however, the wood for these mills generally comes from afar, and there are plants in New York State, that obtain their raw material from Canada, which have to pay around $40 a ton for the delivered pulpwood. At the point of shipping, the average price of that wood was approximately $12 a cord. Broadly stated, it requires about one and one-half cords of non-resinous logs to yield one ton of wood pulp. Manifestly, the cost of the finished product will increase as the journey from the forest to the mill is lengthened. The pulpwood consumed by our pulp manufacturers in 1920 entailed an expenditure of $116,405,720.

Down in the Southern States, where the long-leaf yellow pine flourishes, the forests are being stripped of their timber at the rate of nearly 4,000,000 acres annually. There are today more than 30,000,000 acres of these denuded tracts in the Southland, and because of the difficulties incident to removing the stumps probably not one-tenth of these quondam forests have been made fit for agriculture, even though the potential productiveness of the soil is fully recognized. Moreover, when one of these resinous pines is felled only about one-third of the tree ever reaches the market in the form of lumber; and the prevalent wasteful methods of tapping the pines for turpentine are killing yearly an appalling number of them. But why concern ourselves with the resinous pines when resinous woods are utilized to but a minor extent in the making of paper? Because long-leaf yellow pines offer the means by which to decentralize our paper-making industry and assure us an enormous quantity of raw material which can be put to use in the manufacture of wood pulp and of by-products of great value.

Of the several chemical processes for the pulping of wood, the sulfate process is the one peculiarly suited to deal successfully with resinous woods, and it is this process which bids fair to give economic importance to the big stump-dotted areas in the South which have hitherto been deemed little better than worthless. The imminence of the new era is the climax of the efforts of engineers, chemists, and business men, during the past seventy-odd years, who have striven along three main lines to garner the wealth stored in those billions of charred or weather-blackened stumps. Latterly, this subject has engaged the attention of a group of New York industrial engineers, and their achievements both in full-sized plants and in a miniature duplicate of a commercial mill have opened a sure way for future operations on an extensive scale. This is the outcome of substantially six years of research.

Before describing what Joseph H Wallace and his associates have made practicable, it might be well to outline the paths previously pursued by inventive genius in approaching this problem of conservation. The first of these aimed to obtain tar, pitch, and charcoal from the stumps and the trash wood by subjecting them to destructive distillation, the value of these commodities being counted upon to offset in a measure the cost of clearing the land. Since pine oils have become useful in the flotation treatment of certain minerals, this utilization of forest waste has proved moderately profitable.

The next endeavor was to tap the treasure house of vegetal riches by means of the so-called "steam-and-solvent process." The procedure consists in cutting the wood into fine chips, then steaming the latter in a closed vessel under sufficient pressure to distil off the turpentine—the residual woody matter being afterwards dried and burned for fuel. This process became commercially worth while only when it was discovered that resin could be extracted in paying quantities if the by-product chips were acted upon by a suitable solvent.

The third essay sought primarily to put the fiber of the wood to service in the manufacture of pulp and paper. The resinous nature of the raw material, however, offered a serious stumbling block to this undertaking, inasmuch as the wood would not yield readily to the acid pulp methods commonly relied upon by the industry. Such was the state of the problem in 1906, when it was learned here that pulp mills in Scandinavia were getting good results with the sulfate process when handling wood containing considerable resin. Following very promising work in their laboratory, in producing chemical fiber and paper from yellow pine waste, Mr Wallace and his collaborators shipped a quantity of kindred raw material abroad and made a demonstrating commercial run in a Swedish mill. The outcome was highly gratifying. As an aftermath, a large mill was built in Mississippi in 1912-13, and it was possible there to turn out chemical pulp and Kraft wrapping paper at a lower cost than had ever been feasible elsewhere. Several other plants have been established in the South since, and they have uniformly disclosed the value of waste yellow-pine wood as a basic substance for the profitable manufacture of pulp and paper.

While the three foregoing methods have proved commercially successful in varying degrees, still none of them recovers a large percentage of the total wealth latent in the old stumps and in the logging waste of the region under consideration. For the most part, the various processes have been operated independently of one another and with little regard to their economic correlation. In short, taking the business as a whole, it has lacked stability.

It should be borne in mind that the woody fiber, so essential to the production of pulp for paper making, is destroyed when the wood is subjected to destructive distillation or when it is treated by the steam-and-solvent process. For industrial purposes, the cellulose of the pine is worth fully as much as all of the other substances associated with it; indeed, the superiority of this fiber in the matters of strength and pliability is especially notable. Therefore it is most desirable that the wood be handled so as to make available a maximum amount of this excellent material. And now we come to the most heartening aspect of this whole subject; the story of how research has revealed ways by which several processes can be coordinated and by which the cut-over pine lands, valued at present at about $5 an acre, can be made to give a net return of substantially $600 per acre from the cumbering stumps and wood trash—leaving the cleared areas available for farming or for other uses.

Again, Mr Wallace and his co-workers have evolved a solution of a complex problem through the medium of laboratory facilities; and in consequence of their investigations, begun in 1916, it is today practicable to utilize every bit of the stump and logging refuse in an efficient and profitable manner. Even though stumps may be superficially charred or blackened by long exposure to the weather—having the out-

Cotton growing on southern land, formerly waste, but from which the stumps that made it worthless have now been cleared. And the stumps can be made into paper!

ward appearance of dead wood, still beneath this cloak is a wealth of unimpaired fiber and an amazing amount of resinous matter. Stumps ten, twenty, and thirty years old are, as a rule, substantially sound and capable of yielding prime wood pulp and paying quantities of so-called naval stores.

The new and coordinated system embraces the three following outstanding activities:

1. The manufacture of chemical fiber suitable for the making of Kraft wrapping paper, book paper, and test board.

2. The by-product manufacture of such naval stores as turpentine, pine oil, and resin.

3. The destructive distillation of wood trash—unsuitable for fiber—for the purpose of producing acid flotation oils, etc., as well as a residual fuel useful in carrying on some of the operations.

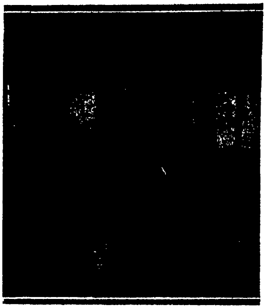
In a broad way, the intention is to divide the work between what might be termed semi-portable field plants and permanent mills conveniently located—the field plants serving as feeders to the latter. Using the processes perfected by the technicists in question the field equipments will turn out turpentine, pine oil, resin, pyroligneous acid, and tar in addition to the main product, pulp chips of a uniform moisture and resin content. A standardized chip is something that has long been lacking and yet a factor very much to be desired in the chemical wood pulp industry. In the absence of it, the making of pulp for paper has been attended with many uncertainties such as the time consumed during some of the stages of preparation, the probable chemical composition of the chip and varying physical qualities that might cover a considerable range. These uncertainties have added greatly to manufacturing costs, and all too frequently have meant the difference between profit and loss.

We are assured that no more complicated apparatus is required than ordinarily found in the run of saw mills and that the labor need be no more skilled. The application of the method involves only the performance of work along prescribed lines and the turpentine, oil, and resin extracted from the chips are of a superior grade. It follows, of course, that the use of a standardized material for pulp making insures a better product, and the experts also claim that it is practicable to get an increased yield. The marked effectiveness of the procedure employed in taking naval stores from the raw chips is principally due to the action of a selective solvent. The nature of this, however, has not yet been made public. Experience has proved that the modest value of the low grade resinous material remaining in the chips after exposure to the solvent does not warrant its removal in advance of pulping. Besides, this resinous matter serves as fuel in the subsequent recovery of the chemicals utilized in pulp making.

A survey of cut-over pine lands in Texas, for instance, has shown that there is commercially available per acre an average of 7¼ cords of pulpwood and 4½ cords of trash wood. Taking the prices prevailing last year the 7¼ cords of pulpwood would yield 8¼ tons of Kraft paper worth $375; from the chips preliminary to pulping the field plant would extract prime naval stores to the value of $147.50; and the treatment of the trash wood by destructive distillation would give turpentine, pine oil, tar oils and pitch capable of bringing $98, making a total return of $620.50 per acre. This figure does not include the value of the fuel that must be burned to run the distillation plant or of the solvent obtained during one stage in the operative cycle of the entire system. It is estimated that an outlay of $30 per acre would cover the charge for clearing, i. e., $15 for the land and $15 for the material taken therefrom. Apropos of this whole subject of a more economical employment of waste pine wood, it should be pointed out that sawmill refuse is plentiful throughout the Southern States, and this raw stuff can be had for pulp making in well nigh unlimited quantities at $1.50 a cord. Aside from this source of supply, however, there is enough workable material in the abandoned timber lands to keep the modern system going on a splendid scale for three or four decades to come. Further, by replanting the cleared areas with yellow pine seedlings a second marketable growth fit for lumber and for pulping purposes can be counted upon in the course of 30 years. The long leaf pine grows fully twice as fast as the northern spruce.

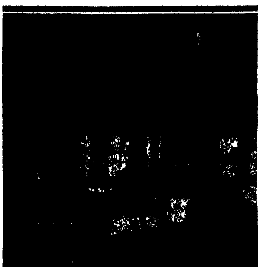
A fact not generally realized is that the sulfate fiber from yellow pine wood waste is by no means limited to the making of wrapping, envelope and bag paper, not to mention box and carton boards of the higher grades, but is equally applicable to the manufacture of *many other lines of finer products, e. g.,* book, magazine, stationery, writing paper, etc. It is authoritatively stated that in whatever directions chemical fiber now dominates the field because of its virtues, there sulfate fiber from our southern pine waste will for the same reasons eventually hold sway, while in all branches of papermaking where fiber strength may be an important consideration this newer commodity will outrank all of its competitors.

Finally, by clearing off the cut-over pine lands in the manner described, great areas will be made available for agricultural development, and where tracts have thus been turned into farms the abundant productiveness of the soil has been demonstrated conclusively. This is a matter of vital moment to millions of our citizenry.



The digester and diffuser employed in demonstrating, on a laboratory scale, the practicability of making paper from the yellow-pine wastes so plentiful in the southern states

The miniature beating engine, a faithful duplicate of a regular paper mill machine, which has been employed in showing how the cellulose of yellow-pine stumps can be turned to a handsome profit



Semi-commercial extraction plant used in developing a process for the manufacture of high-grade naval stores in connection with the large-scale utilization of yellow-pine wastes

Radiant Heat Versus a Gale

DURING the coldest days of the winter pedestrians who passed by a certain store window in New York were almost without exception caused to jump slightly as they unexpectedly and suddenly came within the invisible shaft of radiant heat thrown out across the sidewalk by a mammoth electric bowl heater made only for advertising purposes and using about fifteen times as much energy as the common bowl heater such as is often used to heat a bathroom on a cool morning. One of the most remarkable things about this method of heating is that it is not affected by any degree of wind; the wind does not blow the heat away or to one side in the slightest degree. Moreover the heat passes through the intervening air and glass without heating it. These characteristics set up a fine illustration of the difference between radiant heat and sensible heat, which, if exactness is required, are two separate and different things which are given the same name. Is it not true, then, that radiant heat and sensible heat are both forms of heat? Would they not both heat the hand that is brought to them? The truth is, both kinds give the same report to the human nerves. But the one sensible heat is the only one we have sense-organs capable of perceiving, while the other radiant heat gives us no report at all until it has impinged upon our skin, where the ether vibrations which constitute radiant heat set up molecular vibrations which are sensed as heat. What we then perceive is not the original heat at all, but the effect of it translated into the same molecular vibrations that occur in a piece of hot iron. A hot iron can warm the air around it, but the passage of radiant heat will not, for it is not transmitted by the air but by the ether. Like light, it finds the air no obstruction. When it strikes an opaque object, however, it stops, sets its molecules into vibration, that is, warms it; and from this it is given up to the air as sensible heat of the sort to which we are accustomed.

Since the ether is in no way influenced by the wind, the beam of radiant heat reaches out into the winter breeze passing through the window without heating it, except in a slight degree owing to the presence of impulses in the glass.

The beam of heat thrown by an ordinary automobile headlight will be very strongly felt if we step in front of it when the car is standing, whether there is a calm or a strong wind. If a radiant electric heater were placed in a room having walls of high grade glass there would be no heating of the room. But if some opaque object were placed in line with the heat ray or beam, such as a piece of furniture, the room would soon warm up.

Our Point of View

Our First Psychic Tests

THE REPORT on our May seances got into the July issue only by our taking a form off the press after printing had commenced. The page corresponding to the present one, however, was so far advanced that editorial comment necessarily went over until now. Such comment must take several directions.

Adherents of the medium have described to us phenomena obtained in their presence which go far beyond anything done for us, and which, if accurately reported, would call either for genuine mediumship or for extensive confederacy. These manifestations we have not felt called upon to explain or to deny. We have no concern with what the medium has done at other times and places and under other conditions than ours. All we need say and all we can say is that there was no evidence that the phenomena produced for us were genuine, while there was every indication that they were not. Our Committee's conservative statement is due not to absence of conviction, but merely to scientific repugnance against a verdict covering more ground than the investigation had covered.

Our electrical apparatus has not been questioned *per se*, but doubt has been expressed that its data can lead to so categorical a conclusion. Its sensitivity was such that a weight of nine pounds in the medium's chair was sufficient to keep the tell-tale lamp alight. This should dispose of any idea that its recorded lapses were due to the medium's restlessness, and it should laugh out of court the suggestion that enough "ectoplasm" was abstracted from the medium to bring his weight below the sensitive limit of the apparatus. The fact that the medium was in no species of trance should outlaw the various other oblique explanations of his activity. The claim is made that fifteen seconds is an absurdly brief interval to convict a man on, but this is utterly contrary to fact—in terms of the simple phenomena of these seances fifteen seconds is an enormous time.

Numerous wise folk of the offensively hard-headed type have scoffed at the elaborate methods used. It is much simpler than that to trip a medium, they say; one needs only to flash a light. Replying sarcastically, we should exclaim, "What a pity we did not think of that!" Meeting these gentlemen on their own level, we should point out that after sitting in total darkness for an hour or more the flashing of an adequate light would leave one blind and confused for a time quite sufficient to enable anything suspicious to be covered up. Making the simple statement that we had promised not to flash a light, we should doubtless shoot far over the heads of these critics. But even so they must realize the dictates of expediency. Surely the way to establish our veracity against the medium's is not to start from a broken pledge; surely the way to get more mediums to come forward is not to employ bar-room tactics with the first applicant. If questioned why we ever made such a pledge, the answer may be again on the ground of expediency—though we prefer to answer by saying once more that we are not investigators of the sort who "know" before they start that the medium is a fraud, and that if there be genuine mediums there is very good reason for not flashing a light while they are at work. We hope it is settled that our investigation is a matter of science, not of assault and battery, and that any medium may come before us with the expectation of proper and courteous treatment.

On grounds which we have already catalogued in rebuttal, we have been criticized as unduly credulous. There has been the assumption that our reports would lean toward the psychic side, and the attempt to discount them in advance on this expectation. We hope the outcome of our first tests will have spiked this idea that we are convinced before we start, and will have made it clear that any favorable report which we may render will be based upon facts calling for such report.

On the other hand, all psychic believers must realize that our conditions and procedure were proper. Indeed, when sitting under very sharp controls, the medium felt so free from restraint that he displayed some impatience to know when the tightening-up process was to begin. We will say very frankly that in our view anybody who objects to the conditions of these seances as in any way inhibitive of the best action of the psychic forces would better admit explicitly that any apparatus or any methods whatever that look toward the prevention or detection of fraud are inhibitive.

It should be remembered that we have not sat with all mediums, or even with a medium of wide reputation generally admitted to have produced surprising results under reasonably severe conditions. We have sat with a single medium and have had a very mediocre performance, not even up to the standard of high-grade fraud. Total darkness made it a matter of some finesse to demonstrate its true nature, but that is the best that can be said for it.

Accordingly, it is necessary to refrain from drawing unduly general conclusions from the present findings, and this necessity cuts two ways. That all mediums are frauds and all phenomena fraudulent is either true or false, but nothing tending to establish its truth or falsity has come out of these three seances. On this slender basis one might as well conclude that all mediums are from Pennsylvania as that all indulge in trickery. Equally one should not get the idea that professed psychic researchers are called upon to deal with nothing less trivial than the phenomena presented to us by this medium. The charge of incompetence has been brought against psychic investigators in general because of our rapid success in winding up this case, but such charge is quite contrary to the facts, and demonstrates only the ignorance of those who bring it.

Mr. Lasker on the Shipping Board

THE PERIOD of two years, for which Mr. Lasker, at the request of President Harding, agreed to undertake the chairmanship of the Shipping Board and endeavor to bring order out of chaos having elapsed, he announced his retirement, and in a report to the President gives a concise statement of what has been accomplished in his gigantic task of salvage and organization.

A gigantic task truly, for not only was the investment of public funds thrice that of any commercial enterprise in history, but, conceived as a war-time effort and praiseworthy as such, it was an attempt to create a vast merchant marine by compressing into months the natural growth of generations, and inevitably "was doomed to disaster." Thus Mr. Lasker tells us that the administration of the fleet "was not remotely competent"; that the boats had lost the confidence of American exporters; the operating deficits averaged $16 000 000 a month, "no accounting system worthy of the name existed," and an unrecorded residuum of $150 000 000 war claims remained to be settled.

One of the seemingly unsolvable situations confronting the new Board was the 56 shipping companies, who had bought 184 ships at war-time prices and, because of an 80 per cent decline in ship values, were bankrupt or facing bankruptcy. After months of study, 40 of these concerns were rescued and "preserved for the American flag." The Shipping Board has now "the most complete and accurate accounting system in the Government service," and the Director of the Budget recently stated that "the Shipping Board is the only Government agency with a monthly trial balance." By June 30 the Board had practically settled at 12 cents on the dollar the above-mentioned claims amounting to $150 000 000.

The Emergency Fleet Corporation, charged with the commercial operation of the ships, has reduced the monthly deficit of $16,000 000 to $4,000,000 a month, and has provided nearly two-score freight lines, giving efficient service on every ocean trade route. Passenger and freight ships flying the American flag have brought the United States six days closer to South America, and in the Pacific are rapidly expanding trade relations with the Orient. It is believed that with the entry of the "Leviathan" into service we shall make rapid progress in the North Atlantic, where the competition is keenest.

On taking office, the Chairman promised to offer a policy which might prove the basis of a permanent merchant marine. On this score Mr. Lasker emphasizes the fundamental difficulty that physical operation costs are from 10 to 15 per cent higher than on foreign vessels, the difference being due to legislative restrictions, higher capital charges, better wages and better living conditions for the crews. The so-called Subsidy Bill aimed to equalize the conditions. Since Congress failed to pass this measure, "the apparent alternative is to go the full length of Government operation." Because of the inherent disadvantages of this, as compared with private ownership, the Board has advertised its established lines for sale. The result has been disappointing, and, in view of this, it is believed that "the Government is warranted in assuming the task of direct operation." Justification is found in the guarantee, thus afforded, of an adequate merchant marine in the event of war.

So Mr. Lasker recommends the operation by the Fleet Corporation of twelve to eighteen subsidiary corporations, whose general policies it shall control. This control should be with a view to ultimate sale to private owners. Such a scheme will call for 300 ships of 2 000,000 deadweight tons. This will leave 1200 surplus ships, many of which are inoperable and should be broken up. Of the balance, 200 ships of 1,750 000 tons deadweight should be selected as a reserve. The above vessels plus our coastwise ships, would give us a merchant marine of 7,500,000 tons deadweight, a total which would place us in second position among the maritime powers.

The Demand for Air Laws

DURING the year 1922 there were 134 airplane accidents involving 69 fatalities, and 107 persons were injured through airplane accidents. An analysis of this record by the Aeronautical Chamber of Commerce of America, as given in its annual report to the Secretary of Commerce, strongly stresses the fact that, if casualties are to be reduced, the Government must provide air laws and exercise jurisdiction over all civil flying. Just why civil flying is specified will be obvious from the following facts.

In 1922 approximately 1200 civilian airplanes were in operation in this country and between 550 and 600 were owned by individuals and organizations who possessed fixed bases and practiced conservative business policies. An equal number were distributed among itinerant pilots who have no particular system and depend for a living upon stunting, barnstorming, tours and extra hazardous assignments. In view of these facts, we are not surprised to learn that during the year there were 122 accidents among the itinerant or gipsy pilots and only 12 among the fixed basis operators. These accidents, we are told, resulted in 62 fatalities among the gipsy pilots and only seven among the fixed-basis operators. Analyzing the accidents among gipsy flyers, the report states that 37 were due to lack of inspection of their equipment, and that these would have been prevented by Government licensing and other regulations. Poor piloting caused 46 accidents, 35 were caused by stunting, 11 were caused by obstructions in the flying fields, 14 were due to lack of landing fields, and nine due to lack of data concerning the flying route, as a result of which the pilots became lost and were driven off their course.

The moral of all this is the urgency of the call for Federal regulation. Year after year our Congressmen have been urged to pass laws for the regulation of flying and the licensing of pilots, etc., and year by year they have been neglecting this duty which they owe to the nation. It is not only that there is a deplorable and unnecessary loss of life, but these ever-increasing.

Our Point of View

tragedies disturb the public mind and prevent people from investing in a system of transportation which they wrongly believe to be not yet safe and practicable. No thoughtful person who contemplates the achievements in aviation can doubt that it is destined to prove as serviceable in peace as it did in the World War, but its extensive commercial development will never be assured until Congress is aroused from its present indifference. This awakening will come just as soon as constituents bring pressure to bear upon their representatives to pass the greatly needed legislation.

Does Railroad Electrification Pay?

THE QUESTION as to whether the change from steam to electric traction on steam railroads results in a net profit, is difficult to answer. Many notable substitutions of this kind have been made on our main railroad systems, the first great venture of the kind being the electrification of the four-track system of the New Haven Railroad between New York and New Haven. It is true that in the total length of line thus converted there are others which surpass it, notably the electrified mountain division of the Chicago, Milwaukee and St Paul Railroad. The preeminence of the New Haven electrification is due to the fact that it covers a four-track main line which carries an extremely heavy passenger traffic, probably the heaviest of its kind in the world, to say nothing of its heavy freight traffic. The work included the service into and out of the New York terminal, with the immense amount of switching and the multiplied train movements, both passenger and freight, which are involved in a great terminal of this kind.

The electrification of the New Haven system was forced upon the company by the legislative demand that they should abolish steam traction at the New York terminal, and the change was regarded in railroad centers as a more or less doubtful experiment on a vast scale. The original installation covering the 33 miles from New York to Stamford, Conn., was followed by extension of the electrification to New Haven, and then the complete electric operation of the heavy freight traffic. Naturally, the engineering world has awaited with no little interest the publication of the relative economy of steam and electric traction, developed on this great scale. The results have recently been made public in an article by Sidney Withington, electrical engineer of the New Haven System, in an article published in the *Railway Review*, in which the writer emphasizes the fact that while the "direct" savings can be accurately tabulated and make an excellent showing, they will not in themselves usually justify electrification—this because of the heavy overhead charges due to the high first cost and other considerations.

On the score of direct savings due to reduced fuel consumption and motive power maintenance, we are told that, even after allowing for recent decrease in steam locomotive coal consumption, due to the use of superheated steam and other improvements, the annual saving in fuel due to electric operation is about 200,000 tons of coal per year. The significance of this result will be appreciated when we learn that the electrified rolling stock includes 108 electric locomotives and 79 multiple-unit cars with an annual mileage of 4,928,000 locomotive-miles per year, 58,897,000 car-miles per year and [illegible] million ton-miles per year. On the other hand, the charges against electrification includes interest, depreciation and taxes on the heavy additional investment, the operation and maintenance of the transmission and distribution systems; and other minor items of cost which do not figure in the cost saving, as given above.

To the credit of electrification are to be placed the many favorable and incidental advantages resulting from the change. Thus, multiple-unit equipment has eliminated terminal switching and dead-head movements, and has speeded up operation, especially during the rush hours of the morning and evening. Also the [illegible] track facilities has been postponed for a number of years. And the credit for the saving in the cost of such construction must be granted to the electrification. Furthermore, the passenger tracks at the Grand Central are on two levels, something which would be impossible under steam operation. Therefore, electrification must be credited with having reduced the necessary terminal area, which under steam operation would have to be twice what it now is. Also most important is the fact that the area above the present terminal is available for commercial buildings, and the revenues from this source we are told if capitalized, amount to more than the entire cost of installation in both the New York Central and New Haven electrified zones. This, of course, is a special local condition and will never apply in the electrification of stretches of main line which include no great city terminal.

Saving 160,000,000 Tons of Coal

WE HAVE no economical problem confronting the United States today that makes a more insistent demand for close attention than that of the conservation of our fuel resources. The annual consumption of coal and oil is increasing so fast as to lay heavy emphasis upon the prediction, so frequently made in these days by competent authorities, that the exhaustion of our fuel supplies is being brought within measurable distance. Hence, it is an imperative duty laid upon all large users of fuel, both to practice economy in its consumption and to utilize every source of fuelless power that can be rendered available. Preeminent among these is water power, of which the great rivers, streams and lakes of this country afford a vast potential supply.

Of the many proposals which have been considered and worked out on a practicable basis, the most ambitious and most carefully elaborated is that known as the super-power zone, which comprises the territory extending from Boston to Washington, and reaches inland from the coast for a distance of 150 miles. Speaking of this project, Mr William S. Murray, chairman of the Super-Power Survey Commission of the United States Geological Survey, recently said "If the electric utilities within this zone were to meet the future load requirements by extending their power facilities jointly in the construction of large hydro-electric and steam-electric plants they would save yearly 50,000,000 tons of coal" He based this statement on the fact that the average fuel consumption of these utilities during 1919 was 2.76 pounds per kilowatt hour, and that if we were to include the coal rate for the railroads and the industries, this would mean that such a figure would be changed to not less than four pounds of coal per horsepower hour.

We have made wonderful strides in the development and use of electric power, but Mr Murray points out that the last and greatly needed stage of electric utility expansion is still ahead of us. He believes that ultimately the separate electric utilities will go out of the power production business, and that they will receive wholesale electric energy from certain great power companies. These companies will be entirely outside of the corporate existence of the various electric utility companies, whose function, thenceforth, will be to distribute energy, so received, to the customers within their franchised territorial limits.

The super-power zone scheme involves of course a large dependence upon the hydro-electric possibilities of the Niagara and St. Lawrence Rivers, and in the close of his address at the recent commencement of Lehigh University Mr Murray gave in some details his calculations of the amount of power which is running to waste on these rivers. Translating his totals into terms of coal consumption, he finds the utilization of these rivers would mean a saving of about 160,000,000 tons of coal annually.

The SCIENTIFIC AMERICAN is an ardent believer in the merits of the super-power zone scheme, and in the economic utilization of the immense reservoir of potential energy with which nature has enriched the United States on its northeastern borders. We say this with full consciousness of the sacrifice which would be involved of the spectacular features of the Niagara River, but, in view of the rapid increase of our population with its enormous future consumption of fuel, we feel that this at least is one instance where sentimental considerations must ultimately bow to the stern demands of utility.

A Great American Venture

THE PLACING of the "Leviathan" on the trans-Atlantic route in competition with the long established foreign lines is the greatest single venture on the high seas in the history of the American Merchant Marine. It is a novel and trying experience, for, although we have run and are now running some pretty big ships in the trans-Atlantic passenger service, not one of them is comparable either in size or in complexity to the "Leviathan." There are critics who claim that only the older companies, with ample experience and a large trained staff to call upon, can place a ship on this route and run her successfully from the very day she enters upon active service. We all know the old saying "Give a dog a bad name", and if the "Leviathan" had started on her first voyage with a crew of between 1200 and 1300 men, unacquainted either with one another or with their officers or with the ship, and difficulties had developed in the engine room, on deck, or in the service of the passengers, there would have been a chorus of "I told you so's" from the sceptics, and the prestige of this great ship would have suffered a blow from which it might never have recovered.

The situation is well understood by shipping men. The foreign services, particularly the British companies, have always made it a point to run trial trips, with a large number of guests, for the purpose of "shaking down" a new vessel, not merely as regards her engine room and crew, but also in the dining room stateroom and social service. Extended trial trips of this character were taken by both the "Lusitania" and the "Mauretania."

The "Leviathan" is much more than just a big ship. She is a gigantic steam power plant, equal in capacity to the large generating stations which furnish power to drive the subways and elevated systems of this city. She is an electric light and power station, with a plant sufficient to light a town of considerable dimensions. She is a large pumping station, whose machinery handles an amount of water which would suffice for the needs of a city, and lastly she is a first-class hotel matching in her luxurious accommodations and her capacity for guests the very finest of our far-famed American hotels. It would be the very height of folly to throw together this great aggregate of men and machinery and expect it to function smoothly without preliminary tests and training. Hence it came about that just as the Government sent the "Leviathan" on a five-day trial trip after reconditioning for the transport of troops, so now it has subjected her to a similar five-day trial after her elaborate reconstruction and reconditioning as a first-class trans-Atlantic liner.

The "Leviathan," as we have said, is a great American venture. Into the work of reconditioning has been put all the experience of the past and many new features which, as we have shown in the article elsewhere in this issue, are designed to render her the safest and most comfortable liner afloat. The men who have done this work, engineers, contractors, draftsmen and even the working men at the yards, have regarded their task as something in the light of a sporting proposition, and we have reasons to know that hundreds of them have worked long hours of overtime without pay, believing that here was a chance to show that what we did 75 years ago, when the little schooner yacht "America" won out at Cowes, we can repeat with the "Leviathan" upon the trans-Atlantic course.

Our Psychic Investigation in Europe—IV

A Sitting with Evan Powell, the Well-Known Welsh Medium, that Was Very Rich in Phenomena

By J Malcolm Bird

Associate Editor Scientific American, and Secretary of the Scientific American Psychic Investigation Committee

WITHOUT any question the best seance that I had in England was that of Monday March 12 with Mr Evan Powell Indeed Sir Arthur who has sat scores of times with Mr Powell stated after the sitting that each of the phenomena that this medium produces he had seen better than they had occurred here but that he had never seen such a satisfactory all around demonstration of Mr Powell's repertoire as that with which we had just been favored There were many things done for which I could not conceive a rational explanation on grounds of fraud

Mr Powell was originally a Welsh coal miner he has now progressed to the dignity of a coal merchant doing a small local business His quarters is down in Wales he runs up to London once or twice a month to give sittings at the British College of Psychic Science for these he refuses to accept a penny more than his actual traveling expenses The College gets more than that for them—a guinea or thirty shillings or some such fee from each sitter the profit going into the general funds of the College

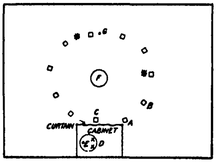
This medium is not one of those sensitive shrinking souls who are so easily thrown off their psychic stride It is his custom to sit securely roped into his chair—or at least to all appearances securely roped and he states that he has become so accustomed to this that he is more comfortable and produces more and better results when bound than when free He reminds you without waiting for you to broach the subject that the phenomena are of no interest or importance unless the sitters can be satisfied that no fraud has been committed and if you omit any of the elementary precautions he insists that you go back and remedy the oversight Either he is a genuine medium or possessed of unlimited confidence

The 'control another American Indian named Black Hawk has the same viewpoint and he will not voluntarily permit one part of the program to be passed for the next number without having assured himself by repetition if necessary that all the sitters have seen or heard and that all have expressed satisfaction with the particular phenomenon in question Black Hawk drags the words fraud and collective hallucination right out into the open during the seance and insists that unless the sitters are convinced that these possibilities have been eliminated the seance is without value Several times a light or a voice or a physical contact was repeated for the benefit of some sitter who had not been sure that it had happened and more than once after a particularly powerful demonstration the sitting was held up while Black Hawk got us all to agree that it couldn't possibly have been collective hallucination He was very bitter and very sarcastic about this explanation

Sir Arthur and I arrived together and were taken to one of the upper rooms where the medium was having a nap He had journeyed from his home to Crowborough the day before to give a private sitting at Sir Arthur's house This had been a brilliant success—so much so that Sir Arthur feared it might have drained the medium to the detriment of Monday's seance The fear turned out to be groundless

We woke Mr Powell who explained that the nap was his custom and not at all a result of Sunday's sitting He finds the process of nervous anticipation the most trying feature of the whole performance, affecting his abdominal regions very unpleasantly—presumably through the solar plexus nerve-center, and whenever he can, he sleeps through this.

He knew that he was to meet an investigator of some importance from America and he was prepared to force me if necessary to take what he regarded as due precautions against fraud. He stripped to his undergarments and insisted that I search thoroughly all his pockets and examine his clothes with full care in other respects and that I assure myself that the undergarments contained only himself I was able to find nothing, except his actual garments plus a handkerchief Then he made me go with him to the wash room while he washed his hands in hot water to prove that he had no luminous substance on them, after which he demanded that I stick to him like a leech until we actually went into the seance room Again I remark that he is necessarily genuine or possessed of unlimited confidence though of course if he were fairly sure that he had something that ordinary examination would not disclose the insistence upon such examination would be the logical thing to distract the attention of the investigator I always did in as slipshod a fashion as possible the things that I was asked to do and devoted as much thought as I could to things that were not thus suggested In Powell's case I found absolutely nothing suspicious before the seance



A The medium B Mr Bird C The clergyman D F The table at the beginning and end of the sitting respectively E G The vase of flowers originally on the table in the cabinet, was found on the floor at the far side of the circle when the light was restored The single crosses mark the position of the two clusters of bells at the beginning the double crosses show where they were found at the end

Diagram of Mr Bird's sitting of March 12 with Evan Powell, the celebrated Welsh medium

For the business of tying the medium in his chair a single long rope was provided and it was insisted that I do the tying with the cooperation of an other sitter who was much the same sort of outsider as I—a clergyman anxious to see for himself what there was in the phenomena

The back of the medium's chair was brought hard against one of the columns of the cabinet and the chair was securely tied in this position The medium then took his seat and the reverend gentleman and I tied him in as well as we knew how He was tied to the chair by ropes about his chest and abdomen his upper arms were tied to the diagonal segments of the chair arms and his wrists to the horizontal ends of these members and his legs were tied to the chair legs Finally the two ends of the rope were brought together beneath the chair and sealed with wax Aside from this point the only suggestions as to method which we received from Mr Powell consisted in his repeated urging that we draw the ropes tighter—we finally got them much tighter than we should have dared draw them if left to our own judgment as to what might check the medium's circulation

On general principles, one is suspicious of a tie made by passing a single length of rope many times about the body, arms and legs There always is the feeling that by playing the slack—some of which always can be made—around from loop to loop until it is all on a single loop, the subject may escape from one of the loops after which that whole loop becomes slack to be borrowed by the other loops We guarded against this by putting non skid knots on every loop When the job was completed, it was plainly one that had been done by amateur hands On this very account it would have been extremely difficult to untie the rope, and tie it up again in the same way and so far as my memory enabled me to judge, the ropes were in the same state at the end of the sitting as at the beginning I should perhaps be prepared to admit, for the sake of argument that the medium might have been able to manage some way of getting free or partly free, without disturbing the ropes appreciably, that he could then have got back would require a much wilder stretch of the imagination to believe.

WITH the appearance in our July issue of the story of our first formal seances, it becomes more necessary than ever to distinguish between these serious scientific sittings and Mr Bird's informal examination of European mediumship This month we have nothing further to report in the way of serious investigation, so Mr. Bird's story of his European experiences must stand alone It may not be out of order, therefore, to repeat that his trip has no connection with our investigation here, save as the experience gained may suggest procedures to be adopted in our American work —THE EDITOR

And yet there was one feature that was profoundly unsatisfactory Everybody knows that when a knot is tied in ordinary sewing cotton, it cannot be untied the thread must be broken As a final step in the tying the medium's thumbs were tied together as they stood annexed to opposite arms of the chair, by an 11 inch length of thread, tied very tightly about the base of each thumb and drawn taut across the space between them Obviously, as long as this thread remained intact he could not by any physical possibility *slip* his other bonds—he could have escaped them only by actually untying them And such untying would be vastly hampered by the presence of the thread If then the thread were found unbroken at the end of the seance, there would be but three possibilities to consider that the medium had remained tied throughout that the ropes had been untied and tied again or that the thread had been broken and replaced A fourth alternative is presented by the possibility that the thread might be broken, and remain so

The second of these alternatives I am prepared to discard the medium could no more have made a series of ties that would have looked like mine, than a competent carpenter could imitate a house that I might build myself The third alternative could apparently have been effected only with the aid of a confederate the medium had no thread if my search of his garments and person was an adequate one Moreover when we came to remove the thread from the bases of his thumbs at the end it was so tight that we could not even get under it to break it we had to slip the point of a pen knife under it and cut it My best judgment would be that it was just as tight as this at the beginning and that even if we waive the question of where the medium could get fresh thread and what he could do with the old thread he could hardly have carried out this substitution

This brings us at the same time to the fourth alternative and to the one suspicious hitch in the whole proceedings At the end of the seance, one of the ladies was about to go to the wall switch to turn on the red light when the control stopped her with the words No not yet He then addressed me, asking me to find the medium's thumb on my side which I did He instructed me to pull on this thumb to insure myself that the thread was intact, which I did, apparently with the indicated result Then he told me to pull harder and break the thread

I think that if the suggestion had not been planted in my mind by the preliminary pull that the thread was intact I should have realized the unwisdom of this request and refused to comply with it As things lay, I realized it the moment after I had broken the thread—but then it was too late The thread resisted my pull for an instant, and then came away and for a moment I had no doubt that I had really broken it Immediately however, it dawned upon me that I had heard or felt no clean-cut snap, and that the sensation given by the yielding thread had been just as applicable to the pulling, out of the grasp of the medium's other thumb and finger, of a previously broken end I really think it more probable that this was what happened, than that I actually broke the thread.

It may be rejoined here that the thread's integrity was immaterial, since I cannot show how the medium could have come free, even had it been broken That is true enough But it is also true that I do not know everything there is to know about ties and escapes; and that the thread was supposed to remain unbroken. If my impressions are correct as to what happened, the medium or the control thought the matter of sufficient importance to trick me about it. If the thread were really unbroken, it should have remained so until the lights were on and we should have been permitted to examine it. If it were

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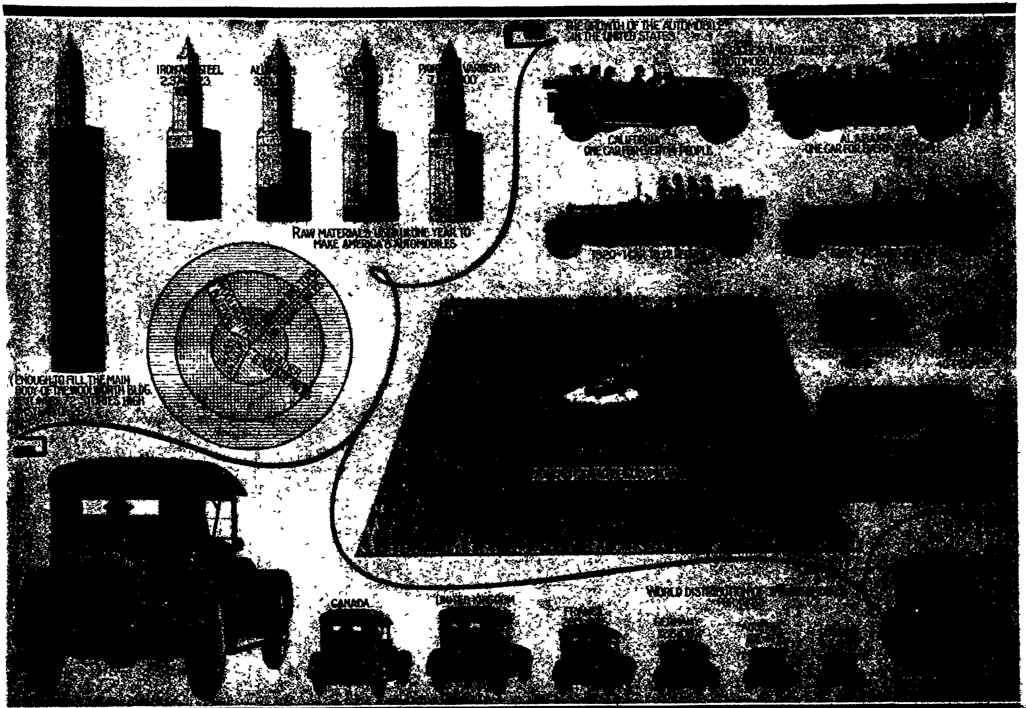


AS usual, the compilation of the automobile license figures for the old year shows that there has been a very large increase in the number of cars in use. This year we have put the comparison on a somewhat novel basis, and have shown just how the relation between the total population of our country and its total stock of automotive vehicles has changed in 18 years. This year it is for the first time reasonably possible to accommodate the entire population of the United States in our cars. If every one of the cars were available for the purpose for each one would have to carry only eight passengers to achieve this result. When we run our eyes back over the figures for preceding years and come to the vast crowd of people who, statistically speaking, pertained to each American automobile in 1904, prediction as to just where the ultimate exhaustion point may be found must falter. The contrast between present figures for our most and our least completely automobilized States is another indication that there is plenty of room for more cars.

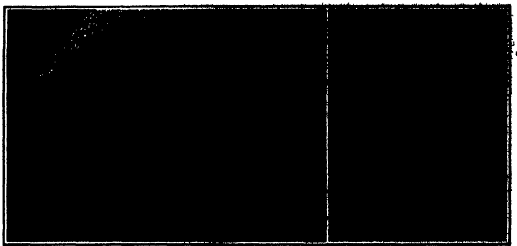
We all know that America is the land of the automobile—though one who confines his foreign experience to Paris and London might be pardoned for doubting it. That the comparison is so vastly in our favor, however even considering our greater population, as the row of drawings across the bottom of the page shows, many of us must have failed to realize.

As our manufacturers, though the foreign buyer scorns our product when he can afford to do so, we stand again preeminent so far as quantity is concerned. Some idea of what the automobile industry means to the country may be gleaned from the graphic demonstration of the raw material used up by this industry. The drawings are self-explanatory here too, save that it may be in order to remind the reader that, as in its companion drawings, the vastly stretched-out Woolworth Building, which we have had to imagine for the lumber, is filled up solid with this commodity; and that the glass, the leather and the curtain-and-top material, which we cannot thus display in solid form, are all supposed to carpet the entire area shown. That is to say, these circles overlap entirely, being truly concentric shapes instead of merely concentric and conterminous rings.

A GRAPHIC SHOWING OF AMERICAN AUTOMOBILE STATISTICS FOR 1923

A Giant Among Gigantic Wind Tunnels

THE strange h rn like object with h t ims the cover picture of this issue is the huge aerodynamic or wind tunnel recently constructed by the aeronautical engineers of the French army at Issy les Moulineaux just outside of Paris. It is part of the magnificent equipment of a large aerodynamical testing plant which occupies extensive buildings and plants and which is intended to keep France well in the forefront in the matter of aviation.



Front and rear views of the giant wind tunnel at Issy-les-Moulineaux, showing the flared air intake and the motor-driven suction fan

The great wind tunnel is built of reinforced concrete and occupies an entire building of its own. It is a somewhat complicated structure on the inside where the models of airplanes and airplane parts are tested in the strong rush of air. The tunnel measures 110 feet in length. At the front end is a flaring member which is designed to draw in air by means of a powerful fan located at the extreme rear of the structure. The mouth of the tunnel is about eight feet in diameter while just back of this comes the square-shaped body the interior of which forms a good sized testing chamber. In this chamber is mounted a structural iron frame which serves to hold the small models in the swiftly moving current of air. The chamber also contains numerous instruments for measuring the speed of the air current pressures, angles of planes, lifting force and so on.

By means of the excellent facilities provided by this tunnel it will be possible to determine with extreme accuracy the performance of any proposed plane or any parts to be used in connection with aircraft.

Behind the testing chamber of this wind tunnel there is a long tunnel some 10 feet in diameter which extends clear to the rear of the structure. At the rear end of the tunnel is the great air fan driven by an electric motor. The fan provides for a maximum speed of air current of some 240 feet per second. As a general rule however the speed is below this maximum and is regulated by means of the electric motor. The blades of the fan are also made adjustable so that they can be set at different angles for varying the wind current. The air fan is about 20 feet in diameter.

This wind tunnel has been constructed after the design of the famous engineer Gustave Eiffel.

A Model Railway in the Workaday World

THE Eskdale Railway is said to be the smallest public railway in the world. presents features of great novelty and interest. At first sight it is difficult to regard it seriously and our illustration will inevitably provoke a smile. Nevertheless it is not a toy or model but is of real commercial utility and as an engineering feat on a small scale it is unique. It is in fact the result of a remarkable development of the model locomotive beloved of most boys and indeed by many more adults than one might suppose.

Constructed in 1876 the line was originally of two feet nine inch gage and was used for the conveyance of iron ore from mines in the neighborhood of Boot a little village in Eskdale to Ravenglass on the coast of Cumberland, where it joined the Furness railway. After serving a useful purpose both as regards mineral and passenger traffic for many years the mines at Boot were closed down and after valiant efforts to maintain it, the railway itself fell into disuse in 1913. In 1915 however a company known as Narrow Gauge Railways Ltd.,' obtained a lease of the line which they converted to 15-inch gage, the original rails, weighing 40 pounds a yard being relaid. The line was then equipped with the biggest model locomotives and rolling stock in existence, constructed by Messrs. Bassett-Lowke Ltd. the well known model railway makers of Northampton and London.

The line is just seven miles long. Starting from the terminal station at Ravenglass with its single platform it passes through four intermediate stations Muncaster (1¼ miles), Irton Road (4¼ miles) Eskdale Green (4¾ miles) and Beckfoot (6½ miles) and ending at Boot half a mile further on. After leaving Ravenglass the line drops down to Muncaster which is only 17 feet above sea level but subsequently it rises by a series of sharp gradients—in one case as steep as 1 in 35—to a height of 210 feet at Boot. It passes through charming scenery and, with Boot, or one of the other villages on the line as a center, delightful excursions may be made and grand panoramic views of the whole Cumbrian group of mountains obtained. Or one may visit Wastewater one of the wildest and most picturesque lakes of the district, or climb Scaw fell or one of the other mountains of the group. There is an excellent service of trains each way, both on weekdays and Sundays.

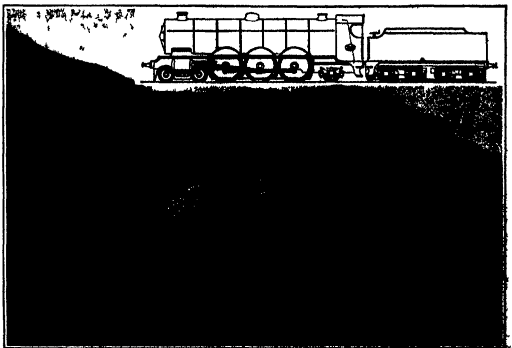
There is a hoary old joke against one of the big English railways to the effect that passengers are requested not to alight and pluck flowers whilst the train is in motion. We do not know whether the management of the Eskdale railway have facilities in this respect to passengers, but at any rate persons desiring to join a train may do so at intermediate points between stations by means of hand-operated signals.

A maximum speed of 25 miles an hour is attained by the locomotives which are also capable of drawing a load of 17 tons on the level at a speed of 14 miles an hour — quite a respectable performance. The journey from Ravenglass to Boot occupies about 30 minutes, and about 78 passengers constitute a full load for a passenger train.

Each open coach accommodates eight persons (two abreast), the weight of an empty coach being about eight hundredweight. Wind screens and awnings are provided for protection in wet or in hot weather. For winter traffic, closed bogie coaches are run that weigh 24 hundredweight empty, and seat 12 persons inside and four on end platforms. An ordinary summer train comprises nine open coaches.

Without question the most fascinating features of the Eskdale railway are its one-quarter scale model locomotives. The most up-to-date models are of the "Pacific" type. The engines are fitted with superheaters, and the rolling stock is provided throughout with vacuum brakes. There are, in all, 5 locomotives, 23 freight cars and 27 passenger coaches.

It is an interesting fact that, whereas the development of narrow gage railways generally has been a matter of accommodating practice on broad and standard gage lines to smaller gages, in the case of the Eskdale railway it has been one of development in the opposite direction, namely, of improving upon the design of scale models and constructing model locomotives capable of doing really useful work.



Scale one-quarter full size. *Weight*, in working order with tender, [illegible] tons. *Length*, over buffers, [illegible]. *Height* to top of chimney [illegible] feet [illegible] inches. *Working pressure*, 140 pounds per square inch. *Cylinders*, [illegible]. *Heating surface* [illegible] square inches. *Driving wheels*, [illegible] inches diameter. *Water capacity of tender*, [illegible] gallons. [illegible] 25 miles per hour. *Hauling capacity*, 17 tons at 14 miles per hour on level track.

Eskdale railway passenger locomotive "Colossus," built by Bassett-Lowke of Northampton, England

Intelligence Tests and Immigrants

IN the *Scientific Monthly* for November, Professor Kimball Young discusses the results of applying intelligence tests to various immigrant groups in America. He points out that whereas up to the year 1882 the highest percentage of immigrants came from the British Isles and northern and western Europe, of recent years a complete change has taken place the highest percentage now being from southern and eastern Europe. This change, he considers, is of the greatest importance for the future of America. If the more recent additions to America are of a less intelligent stock than the earlier inhabitants, then the consequences will be serious for the future. In order to test intelligence, the writer used the already well-known American Army tests, modified to suit the children he was testing and he also considered the work of others studying racial differences by like methods. As a result of a very careful study he brings forward evidence to show that the intelligence of these southern European stocks is very much lower than that of the other stocks. If that is so, then the continued dilution of the original, more intelligent, stocks by these inferior ones will seriously affect the average intelligence of the population of the country. As a practical deduction, it is urged that there must be a complete change in public opinion on the desirability of large numbers of immigrants; and, secondly, that [illegible]

Heavy weather in the Atlantic race. The American yacht is carrying a storm trysail on her mainmast; the British competitor has a reef in all three sails

The Trans-Atlantic Race

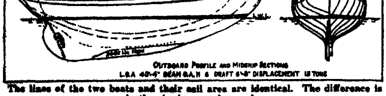
In this Test of Skippers and Sail Plans the Two Hulls are Identical

IN THE sport of yachting the present era must be written down as that of the small racing craft, which seems to have monopolised the field so far as international competition is concerned With the exception of the race to Bermuda, the international competitions this season are represented by the race in British waters between American and British 6-meter yachts, and the trial of speed and skill in the trans-Atlantic race between the two very interesting 40-footers shown at the top of this page

The two yachts were built in the spring of this year, one for the Earl of Leinster and the other for Mr W. Washburn Nutting, editor of *Motor Boat* It was stipulated that they should be 40 feet long overall; that they should be identical in the design of their hulls and in their construction; and that they should each carry not over 800 square feet of sail. Within the restriction as to total sail carried, each skipper was free to adopt the type of rig which he considered the best for an ocean race of this kind. Mr. Nutting selected the schooner rig, and the Earl of Leinster the ketch rig, which is greatly favored among British yachtsmen. The exact dimensions of each yacht are: length on deck, 40 feet 4 inches; waterline length, [illegible] feet 6 inches; beam, 11 feet 6 inches; draft, 6 feet 8 inches; displacement, 30,506 pounds. The iron ballast on the keel weighs [illegible] pounds. The actual sail area of each boat is [illegible] square feet. The boats are both auxiliary, the Nutting boat carrying a [illegible] 2-cycle engine of from 12 to 15 horsepower, and the British boat a 2-cylinder 4-cycle engine of [illegible]. By the rules of the race each boat is allowed [illegible] gallons of gasoline and the skippers are free to use the engines when and where they will until the fuel supply is exhausted The original proposal was to sail the race with only the skipper aboard, but it was realised that the pleasure of the race would be greatly enhanced with two aboard and it was agreed that each yacht should carry a crew of two men

The sail plan of the American boat shows that she carries a jib, a gaff foresail, and a jib-headed, leg-of-mutton, or Marconi mainsail, as it is variously called Jib-headed sails have come into great favor of late years, not merely in small yachts such as these, but in the large racing craft, as shown by the fact that a request was made by Sir Thomas Lipton that he be permitted to use this type of mainsail on "Shamrock IV"

Mr Nutting, who is an expert in deep-sea cruising in small yachts, has this to say in speaking about the respective merits of jib-headed and gaff-headed sails. "Every indication points to the fact that the jib-headed sail is the future sail for small craft On the wind, other elements of the design being equal, the jib-headed rig is the faster, and I have noted that any wholesome type of boat that is fast to windward is more than middling across or off the wind" The ketch rig is favored by the British because of its excellent balance and the speed with which the ketch type can be snugged down in bad weather It is not unlike the yawl rig which is so popular in America, with the difference that the mizzen mast, instead of being stepped at the extreme after end of the boat, is brought forward well inboard and carries a much larger sail than the mizzen in the yawl It is needless to say that in rigging both yachts everything has been done to simplify handling.



The lines of the two boats and their sail area are identical. The difference is in the rigging, as shown above

Comfort and convenience in the accommodations are of supreme importance, and much careful planning went into the layout and fitting of the interior A novel feature is the raised deck between the masts. This deck, as can be seen from our drawing, extends flush across the boat from rail to rail for the full distance between the two masts. The arrangement provides abundance of head room below deck and enables the yacht to clear herself quickly of seas which come aboard amidship. Aft of this deck is a sturdy house with a low deck on each side of it, which will be handy for the storage of waterbreakers, cases of gasoline and other dunnage The cockpit, although small, is large enough to allow a man to get down out of the wind

Below deck there are four full-size berths, and instead of fitting these with spring mattresses, they are provided with canvas, which, lying in a hollow curve, provides the flexibility of a hammock and is a safeguard against being thrown out of one's berth in heavy weather Particular attention has been paid to placing everything so as to call for a minimum of handling and movement to and fro. Our drawing shows the two vessels snugged down in heavy weather The American boat is carrying a loose-footed trysail on her mainmast, with a single reef in the jib and foresail The British craft is carrying a reef in all three sails.

Summer Time and Radio

Recent Developments in Radio Broadcasting that Challenge Warm Weather Handicaps

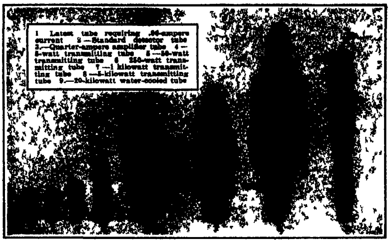
By George V Haskell

RADIO broadcasting is now on a full time basis Or to put it another way this is a radio summer Thousands upon thousands who became radio fans during the long winter months are now maintaining a keen interest in radio especially during vacation days Radio receiving sets are still operating in many homes—and operating remarkably well despite the thunderstorms and noisy static disturbances and the all round reduction in radio efficiency due to warm weather And in the sea shore home the mountain home or lodge the camp, the summer resort, the farm and elsewhere the radio receiving set especially in portable form is very much in evidence Even the touring motorist is now carrying a portable radio receiving set tucked away among his luggage for an occasional bit of entertainment or for his daily news and stock reports and weather forecasts by the wayside or in the motor camp So radio broadcasting is now becoming a summer convenience as well as an indoor pastime of the winter season

Radio communication is at its very best during the cold crisp winter nights At such times there is a minimum of atmospheric disturbances or "static" as the noises of space are called Then too the average receiving set reaches out to the remotest points in an astounding manner as compared with the very much curtailed range during warm weather Winter time reception of speech or music is as clear as a crystal—clearer by a good deal than the usual telephone line Indeed the crystal-clear atmosphere of the winter is as transparent to radio waves as it is to the sight when viewing distant objects

But with the approach of warm weather the atmosphere is no longer as transparent as it has been during cold weather It becomes troubled it loses much of its transparency receiving ranges are cut down radio telephone reception is blurred and distorted extraneous noises grow in number and in volume Radio programs are apt to be broken up in the most aggravating manner

Again warm weather is outdoor weather Heretofore the radio receiving set has been a rather cumbersome installation calling for various pieces of bulky and delicate apparatus particularly a heavy and messy storage battery which did not lend themselves to ready transportation The consequence has been that radio has been left at home when the average American sought the outdoor life of summer time and vacation time Again there has been a strong fear of lightning and the supposed fire hazard attending it in connection with the usual radio antenna or aerial, with the result that many a radio receiving set has been taken down and packed up and stored away with the first signs of warm weather



Vacuum tube family, ranging from the tiny dry battery receiving tube to the giant transmitting tubes

It was so in the summer of 1922 The young radio industry encountered a serious slump with the approach of warm weather The preceding spring and winter marked the real beginning of radio broadcasting The radio industry had come into being with a rush and a phenomenal volume of business was transacted within a few months Stores were at their wits end to provide the necessary stocks of goods for the ever growing crowd of enthusiastic customers It was a case of production not selling Meanwhile the manufacturers were literally swamped with orders and only by the most strenuous efforts did they succeed finally in matching up their production with the public demand The stores at last enabled to procure the necessary stocks of goods took on all the goods they could carry in anticipation of a continued brisk trade

Then with little if any warning the bottom fell out of the radio business The public stopped buying with the approach of warm weather The stores could not move their goods The manufacturers to their intense dismay found many of their orders cancelled and the large flow of quantity production suddenly backing up on them The natural sequel was a cut throat slashing of prices such as no other business has ever witnessed In many uninformed quarters it was freely predicted that the radio industry was a passing "craze" and that the boom had been pricked and would deflate to nothing in short order But to the better informed this state of affairs was simply a marked slowing up of the radio industry during warm weather due to serious lack of foresight on the part of engineers and business men alike to provide for the radio dog days of summer

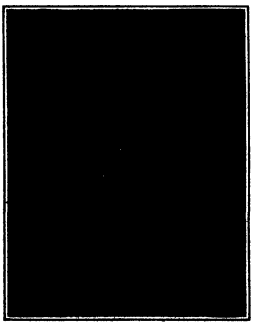
The decline in radio enthusiasm during the summer of 1922 may be attributed to firstly, failure on the part of the radio industry, both from an engineering and business standpoint to meet summer-time conditions and to maintain radio interest secondly, the prevailing fear of lightning thirdly, interference from static and the general lowering of radio efficiency

But bygones are bygones and the radio industry, during the prosperous fall, winter and spring seasons just past has had sufficient foresight, even during the brisk business months, to look forward to the coming warm weather and to provide for it The result is that this summer finds us better prepared to enjoy radio at home and in vacation quarters, and it begins to look as though radio were at last promoted from a part time job to a full time one

To begin with, considerable attention has been given to the summer ailments of radio. Today there are some eight hundred broadcasting stations in regular operation, blanketing every corner of this vast country, as compared with 150 or so during the summer of 1922 The consequence is that anybody, anywhere, with any kind of set, is reasonably sure of nearby broadcasting service No longer is it necessary to strain every effort to pick up a long-distance radio broadcasting program, together with all the static and other interfering noises which come along with weak signals. Broadcasting stations today are powerful and when they serve nearby receiving sets, their signals are sufficiently strong to compete with all noises of space except those produced by a local thunderstorm. So the burden of overcoming summer-time radio ills has been tackled by the broadcasters to a large extent, which is as it should be The logical starting point in tackling static is to produce powerful radio waves which can be intercepted by relatively insensitive receiving sets—sets that are fairly immune to most parasitic disturbances

If one is satisfied with the nearby radio broadcasting programs, there is no reason why radio should not be enjoyed to the full during the warmest weather The long and high antenna or aerial of cool and cold weather is replaced by a much shorter and lower antenna, or, what is still better practice the outdoor antenna is dispensed with entirely in favor of a short indoor antenna consisting of a single wire tucked behind the picture molding and measuring anywhere from 20 to 50 feet long or even a small loop consisting of four to eight turns on a wooden framework measuring three feet to five feet high The smaller antenna or the loop will not intercept as much energy —be it radio signals or atmospheric parasites—as the large outdoor antenna but allowing for the powerful signals of the nearby broadcasters, sufficient radio energy will be picked up to provide clear clean cut radio entertainment It may be necessary in some instances when static conditions are exceptionally bad to use ear phones exclusively temporarily doing away with the loud speaker

As far as lightning is concerned there is little to fear just because one happens to have a radio receiving set The possible dangers of lightning have been grossly exaggerated by the press, in many instances quite unconsciously at the very time the press was actually



Typical portable receiving set making use of dry battery tubes and radio-frequency amplification

Ingenious form of [illegible] antenna which can be readily carried about in collapsed form

trying to reassure radio laymen that there was no real danger if due precautions were taken

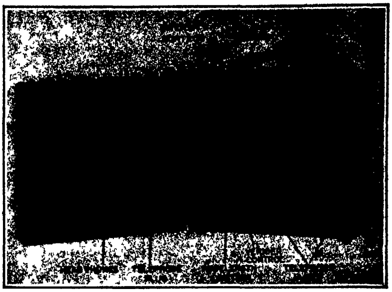
With the several million receiving sets now in operation, there has been no increase in lightning damage. On the other hand, there is no way in which property protection, brought about by the proper grounding of an antenna, can be estimated, but it must be considerable. The mere fact that lightning rods are again being considered in localities subject to severe thunderstorms, should be taken as a recommendation for a radio receiving set with a high, long and properly grounded antenna. The requirements of the National Electric Code, with specifications approved by the National Board of Fire Underwriters, are simple and effective, and when once complied with there should be no further fear from lightning hazards.

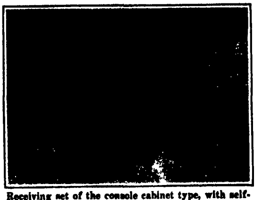
If a thunderstorm is raging in the immediate vicinity, one may as well bring the lightning arrester into play and lay the head 'phones aside. Distinct reception of radio telephone communications is taboo when the angry elements of the clouds are in action, since a local thunderstorm is one of the three outstanding factors affecting radio audibility. Static frequency and static audibility are the other two disconcerting forces that may interrupt the reception of grand opera or break the continuity of market reports by radio telephony

A series of experiments, cooperatively engineered by the Weather Bureau of the United States Department of Agriculture, and the Nebraska Wesleyan University, have been productive of conclusions that tend to introduce the question "Can radio messages be heard in a thunderstorm?" Undoubtedly, if we are to accept the results of these scientific tests, the ability of a radio telephone receiving set to deliver speech or music in distinctly audible tones is thus impaired. In fact, the investigators into the subject of the relationship of weather conditions to radio audibility specify three outstanding factors as affecting the clearness of radio reception These, in the order named by M P Brunig of the Nebraska Wesleyan University, are (1) Static frequency, (2) nearness of thunderstorm area to receiving station, (3) static audibility However the atmospheric conditions at the radio transmitting point do not exert an influence on the audibility of messages at a distant point. For instance, a local thunderstorm in progress in Washington during the transmission of a radio communication from the powerful radio station of the United States Navy Department, would not mar the clear reception of the message in New York City

The fluctuations of the barometer—or the instrument for revealing the weight or pressure of the atmosphere—did not appear to influence the audibility of the radio signals. The absence of relationship between barometric pressure and the state of hearing of radio communications is cause for skepticism on the part of the Weather Bureau of the United States Department of Agriculture, that radio instruments may be employed as a direct means of forecasting weather conditions. Attaching some credence to the theory already advanced to the effect that the use of radio direction finders and the audibility of static or atmospheric disturbances in the radio receiving apparatus are agencies for foreshadowing the approach of storms, meteorologists contend that the essential factors for forecasting are still lacking However, the Bureau of Aeronautics of the United States Navy Department, in experiments covering a period of years, conducted at Pensacola, Florida, and Hampton Roads, Virginia, claims that radio instruments have been effectively employed as weather vanes in foretelling the approach of hurricanes or violent thunderstorms that might prove disastrous to aviators.

Be that mooted question as it may, the results of the tests of the Weather Bureau and the Nebraska Wesleyan University have evolved the suggestion that weather forecast maps can be advantageously employed by radio transmitting stations to determine the handicaps or favorable conditions in the environs of the various radio receiving stations. In these particular scientific observations it was determined that a thunderstorm raging in proximity to the radio telegraph and telephone transmitting station of the Navy Department at Radio or Arlington, Virginia, exercised no effect on the reception of the communications by the Nebraska Wesleyan University, at University Place, Nebraska A radio telephone message originating at this station during a local thunderstorm was heard distinctly at a distant point where no violent atmospheric disturbance was in progress. The barometer readings and the mileage to the nearest thunderstorm area were determined by use of a weather map of the United States for the corresponding twenty-four hours.


Another form of portable receiving apparatus, which will receive with a few feet of wire for the antenna


Receiving set of the console cabinet type, with self-contained dry batteries

All of which boils down to the conclusion that thunderstorms do not interfere with radio reception to any marked degree except when they are in the immediate vicinity of the receiving station Static does not hinder radio telephone reception very appreciably In this respect telephony has one great advantage over radio telegraphy For instance, speech can be carried on after a fashion in extremely noisy public assemblies. The ease in understanding speech under such circumstances is due to our life-long experience Then, too, there is what may be termed "assistance of context." By this is meant the ability of the average listener to fill in lost words which make sense to the entire sentence

Since static and signal are amplified alike, it would seem advisable to suggest less frequent use of the loud-speaker in favor of head telephones, as already suggested, when intense static exists. Vacuum tube amplification, especially audio, should be reduced to a minimum consistent with signal strength

Seldom, if ever, is a program from a local station seriously interrupted by static even when lightning flashes are plainly visible to the eye The audibility of a signal required to obliterate completely the normal static interference is less than 200 and local stations will be found to produce at least 500 times audibility with the average two-stage receiver

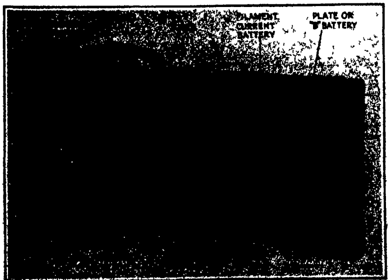
Under the old scheme of things—and anything over a year old is apt to be termed "old" in such a young and progressive industry as radio—the equipment used for receiving over fairly long distances was quite cumbersome The vacuum tubes—those little lamps which are the heart and the ears and whatnot of the usual radio receiving set—have been steadily developed. The first vacuum tubes employed in broadcasting reception required a six volt potential and somewhat over one ampere of current for each tube The heavy current drain even when using a single tube necessitated the use of a storage battery for the filament energy

In due course these first vacuum tubes gave way to others which made use of special coated filaments instead of the plain tungsten wire, and which required somewhat less than one-quarter ampere for each tube. One of these tubes operates on a single standard dry cell, and therefore lends itself to use in a portable receiving set

The latest type of economical vacuum tube requires somewhere between 3 and 4 volts and a current consumption of 06 ampere—or a trifle more than one-twentieth ampere A single tube of this kind will operate on three cells of flashlight battery, and three tubes of this kind can be operated for a long period of time on three standard dry cells.

Due to these economical tubes, it is now possible to produce a receiving set which disposes with the former cumbersome storage battery and which, through the use of several tubes for amplification of signals, is of such extreme sensitiveness as to operate on any kind of a temporary antenna, or even a small loop. There are now being produced several types of portable sets which are considerably smaller than a small suitcase These sets are self-contained, with the filament and so-called "B" or plate battery neatly mounted in the case

The portable sets with their dry cells have taken radio quite outside the home circle when occasion demands. This summer the radio enthusiast has no excuse for not taking his radio set with him on his vacation trip, especially in view of the redoubled efforts of broadcasters to provide better entertainment features, more sporting events, better news service, and so on. The new wave length schedule, now in force, has also contributed materially to the betterment of broadcasting.

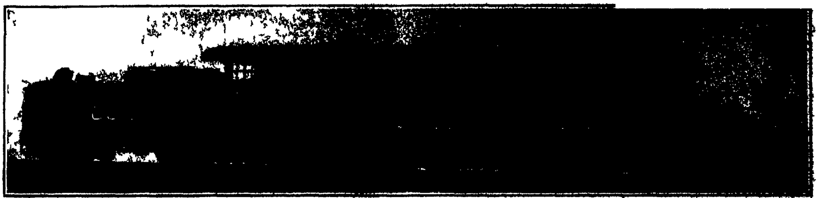


Interior view of portable set shown in upper right-hand illustration

A German Motorist's "S. O. S."

THE slump in German currency necessitates the payment of many thousands of marks for motor cars One would be purchaser, however, has hopes of getting over this financial difficulty by the assistance of the British Automobile Association, which has received the following naive appeal:

"I beg you pardon, Sir, if I come to you with a beg. I am very interest to the Motor sport, and that I have not enough money to buy one motorcar I would you beg to send me some £ If you will not I beg you to ask your colleges that the give me some £. I have one good motorcar to buy I was thankful to you if you despatch some £ as early as it goes."



This locomotive, the heaviest in existence, with a tractive effort of 176,600 pounds, is one of the many powerful steam units which are to be replaced by electric locomotives with a tractive effort of 277,500 pounds

Another Forward Step in Electrification

How the Virginian Railway will Replace Steam with Electricity for Hauling Heavy Trains

WHEN the late Henry H. Rogers decided shortly before his death to use his own private fortune to build a railroad of the highest standard and immense capacity through the coal fields of West Virginia many people thought that his judgment had begun to slip. Scores of advisers sought to save him from the results of his folly and few people believed that the Deepwater Tidewater Railway—or Virginian as it is now called—could ever be financially successful. But events showed that Mr. Rogers' intellect had lacked nothing of its keenness. Within a very few years after operations were started in 1909 the Virginian Railway began to make money and it soon began to make records for earnings that are the envy of almost every railroad in America. For example the ratio of its operating expenses to gross earnings in 1922 was 65.44 whereas this same ratio for two other roads running through the same district were respectively 75.27 and 79.2.

There are three chief reasons for the success of this road. In the first place it obtains continually increasing traffic from the Pocahontas-New River coal fields through which it runs. Secondly it was constructed so as to keep operating expense at minimum with the lowest grades and the smallest number of curves that the character of the country permits. Finally it operates its trains in accordance with a system known as mass transportation which is undoubtedly the most economical method under the existing conditions.

By mass transportation is meant the handling of the traffic by the largest possible trains instead of a much greater number of small trains. In accordance with this policy the Virginian operates the heaviest trains of any railroad in the world hauls them with the most powerful steam locomotives obtainable and has had special 120-ton coal cars and double-duty air brakes designed to suit its special service.

With this equipment seven million tons of coal can be hauled annually from the mines to the sea at Norfolk and until recently this capacity was ample. But now the production of the mines served by the railway has reached this figure and unless the traffic capacity of the railway can be increased in some manner a definite limit has been set to the output of this important district.

The trouble lies at the grades over the Allegheny Mountains. Elsewhere the coal moves freely enough but for crossing these mountains 8000-ton trains must be cut down to 5500 tons and even when each of these smaller trains is handled by three compound articulated Mallet locomotives speeds exceeding seven miles an hour cannot be secured.

This electric locomotive will haul 6000 tons up the mountain grades at 14 miles per hour as compared with steam haulage of 5500 tons at 7 miles per hour

Two things can be done to remedy this situation. More tracks can be built or greater power can be applied per train so as to move the trains up the grades at higher speeds. The first alternative involves considerable expense while the second is impracticable with steam operation for the simple reason that the 6000 horsepower now being applied to each train represents about the maximum power that can be obtained with the use of steam locomotives of any known type.

Electrification however, provides a way out. By using a total of 20,000 horsepower of electric locomotives per train (which is by no means the present maximum possible limit), trains of 8000 tons can be taken up the grades at 14 miles per hour. This practically doubles the present capacity of these tracks and still provides a considerable margin for future expansion. In addition, since electric locomotives require much less care than steam locomotives, are available for a far greater proportion of each 24 hours, and consume power more efficiently very material operating economies could be obtained by their use. For these reasons the management of the Virginian decided to electrify the mountain section of the road, where the difficulty is centered.

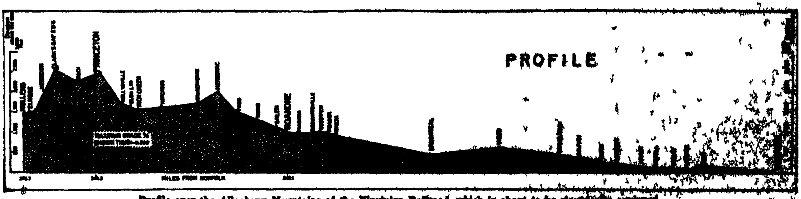
The system adopted according to Mr. R. L. McLellan railway engineer of the company that is supplying the electrical equipment is the alternating-current single-phase system with an overhead trolley similar to that used with such success on the Norfolk & Western, New York New Haven & Hartford the Pennsylvania Railroad at Philadelphia, the Grand Trunk, the Boston & Maine Railroad and the Erie Railroad the Spokane and Inland Railway and the Chicago Lake Shore and South Bend Railroad.

Each locomotive will have the following characteristics

Total weight approximate	600 tons
Weight on drivers	450 tons
T E continuous	185,000 pounds
T E maximum	277 500 pounds
Speed	14 or 28 M.P.H.
Horsepower continuous at 14 M.P.H	5115 H.P.
Horsepower continuous at 28 M.P.H	5970 H.P
Diameter of drivers	62 inches
Length over coupler knuckles	145 feet 6 inches

The locomotive will receive current from an 11,000-volt trolley wire through pantograph collectors; this current will be stepped down by transformers in the locomotive cabs to a low voltage and delivered to the

(Continued on page 141)



Profile over the Allegheny Mountains of the Virginian Railroad, which is about to be electrically equipped

Light Weight Cement Slabs That Take the Place of Lumber in Building Operations

CEMENT slabs recently developed by a New Jersey manufacturer are proving of interest to architects and engineers because of their lightness strength and adaptability to a variety of building operations. The slabs are in sheet form with a thickness of one inch, while in weight they average about 55 pounds to the cubic foot. Six hundred pounds to the square inch is claimed to be the crushing strength, and where this is not strong enough the slabs may be covered with a cement finish varying in thickness from 1/16 inch to ½ inch.

An interesting method is employed in making the slabs. A material resembling paraffin wax is mixed with the cement and sand, and after the correct amount of water is added the mixture is thoroughly mixed and poured into a steel form where the reinforcing wire netting is already placed When the cement has set to the required degree of hardness, the slabs are removed from steel forms and placed on steel cars to be transported and placed in a steam tank where the slabs are exposed to the action of exhaust steam. Here the slabs are heated rapidly so that the waxlike material melts and runs into tanks below One-half to three-fourths of this substance is extracted in this manner. In order to remove the balance of the waxlike material, superheated steam is admitted to the tank until a temperature of approximately 300 degrees Fahrenheit is obtained. In order that all traces of the chemical may be removed it is necessary to carry on this steaming action for 24 hours After a few hours of cooling the slabs are removed to a steam curing room where they are kept wet and hot for two or three days until they have the necessary strength for building purposes. Contrary to what might be expected they do attain ample rigidity for all requirements.

By the melting of the waxlike material a very porous and light slab is formed but it still possesses the important merit of great strength When the slabs are used in building operations in connection with stucco structures, the siding slabs are nailed to wooden studs having the rough face out. This rough face then serves as a base for the stucco Nails may be driven through the slabs easily without any danger of breakage Owing to the peculiar air cell structure of the slabs it is claimed they make good heat and sound insulators. They will also prove useful in places where a material having decided fire-resistive qualities is needed, since exposure to heat water or live steam has no effect on their strength.

Laying the cement slabs on steel girders to form a roof which is inexpensive and permanent

After the cement slabs have been laid to form a roof, they are coated with a cement finish as here shown

Dahlia Sugar

THE cultivation of dahlias has developed so many beautiful varieties, and the flower has been so much improved that it comes with something of a shock to some folks to learn that dahlias are to be grown on a commercial scale for the sugar to be obtained from their bulbs. They will also be surprised to learn that more dahlia bulbs can be raised to the acre in California than sugar beets. Nor does it cost more to raise them. However the dahlia bulb has less of sugar content than the sugar beet, so it will likely cost more.

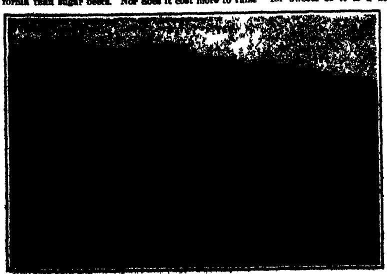
But there is a very good reason for dahlia sugar and that is the fact that it is the only commercial levulose, or fruit sugar, which may be used in a no-sugar diet by patients suffering with diabetes. It appears from statistics on the subject that this disease is increasing in this country and scientists have for some time been trying to find a sugar that people suffering from it may eat At the present time, diabetic patients are almost altogether debarred from using ordinary sugar Statistics state that there are 1 000 000 people suffering from this ailment in this country so the discovery of a formula for making this sugar from dahlias is of great importance to the national health

The new sugar is one and one-half times as sweet as cane or beet sugar and will hardly be a rival to the other sugars as it will be more along the medicinal line In this connection it may be mentioned that sugar was regarded as a medicine or a luxury in Europe up until the time that tea and coffee began to be universally used and not a necessity as it is now regarded

The formula for making the dahlia sugar was worked out in the laboratories of the University of Southern California, and the head of this department Dr Laird Stabler, states that it is now complete

It is said that diabetic patients have a great craving for sweets so it is a matter for rejoicing that they will not have to be wholly deprived of them as heretofore The American people consume more sugar than any nation in the world the consumption per capita in the last year being nearly a hundred pounds This is an increase over the previous year Saccharine was the only sweet allowed those suffering from diabetes, and there has been some controversy in the medical field as to whether this was not harmful to the digestion It has no food properties while sugar has as it furnishes heat and energy for the body

Perhaps when the dahlia fields get to growing, they will be allowed to flower though this is hardly likely as it will probably appear that it would detract from the amount of sugar stored up in the dahlia roots



[illegible] roof made of cement slabs, with the workmen engaged in giving it the finishing water-proof treatment

The Sensitivity of the Ear

UP to the present time there has been no satisfactory technique for loudness comparisons of different tones At the meeting of the National Academy of Sciences in Washington in April Dr Donald Mackenzie of the Western Electric Company read a paper on the relative sensitivity of the ear at different tones. The reader gave a description of an alternation phonometer which makes it an easy matter to adjust to equal loudness two tones of different pitches With this instrument a determination has been made of the relative sensitivity of normal ears of both men and women over the pitch range from bass G to C 5 at sound intensities midway between the faintest audible and the painfully loud. It is found that the sound energy necessary to produce a given loudness is smaller the higher the pitch at least within the range examined Different ears agree more closely at these intensities than at the least audible and no difference is detectible between men and women Interpretation of the results shows them to be in harmony with Fechner's law according to which the difference between the sensations due to two lights of the same color or two tones of the same pitch is proportional to the ratio of intensities of the lights or sounds causing the sensations This simple law holds only at moderate intensities Phonometric comparisons by a small number of observers were made at intensities from very faint to very loud It appears that any one ear varies from day to day, but these variations are most noticeable at the extremes of loudness The results taken all together strongly suggest that on the average the relative sensitivity of the ear to different musical notes is practically the same whether the sounds are loud or faint

Further Tests of Stellar Radiometers and Measurements of Planetary Radiation

THE Bureau of Standards has been conducting for a number of years investigations on the properties of matter for the purpose of improving the instruments and methods used in measuring thermal radiation This has led to production of instruments of sufficient sensitivity to measure the heat of stars and planets The results obtained have opened to astronomers a new field of investigation on the variability of stars, etc

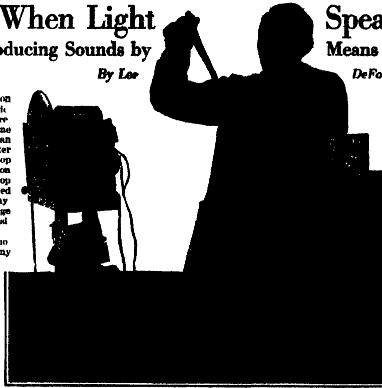
In Scientific Paper No 460 obtainable from the Superintendent of Documents Government Printing Office, Washington D C at 10 cents a copy, improvements are described in the thermocouples used for measuring the heat from celestial objects and preliminary measurements are given of the heat emitted by the planets e g Mars, Jupiter Venus, Saturn etc, as the result of heating by solar radiation

It is shown that the atmosphere of Mars is only dense enough to intercept a portion of the sun's rays so that the surface of the planet becomes appreciably heated and these emanations may be measured On the other hand Jupiter is so far away that its atmosphere is heated but very little by the sun This atmosphere is so thick and dense that apparently the sun's heat cannot penetrate to the surface of the planet, and even if the planet itself gives out heat these rays are all trapped by the atmosphere

When Light Speaks

Recording and Reproducing Sounds by Means of Light Intensities

By Lee DeForest, Ph D.



Dr. Lee DeForest, the well-known inventor of the vacuum tube, with his latest invention, the phonofilm "talking picture" camera

MY ATTENTION was focused on the field of talking moving pictures wholly by photographic recording in 1918 Perhaps the one consideration which more than any other prompted me to enter this field was my desire personally to develop a new and useful application of the audion amplifier—one which I could expect to develop largely by my own efforts as distinguished from its application to long distance telephony where obviously the intensive efforts of large corps of engineers backed by a gigantic business organization, were indispensable

Another motive was my desire to see a phonographic device which would be free of many of the inherent short comings of the disc machine notably the short length of record the necessity for frequent changings of needles and the belief that by means of a pencil of light instead of a steel needle it might be possible completely to escape from the surface scratch which has always been inseparable from the existing types of phonograph

Early in the spring of 1919 I filed patent applications on the methods which I believed would accomplish the above laid-down conditions and began actual research on the various means which might be successfully employed At that time I figured that the work involved should require at most two years—a period one-half as long as that which has actually been demanded The work has been almost uninterrupted and of the most exacting and discouraging nature Literally hundreds of experiments have been made and thousands of feet of films have been photographed only to be thrown away

The Phonofilm as its name implies, is the combination on the same film of picture with voice or music photographically recorded Standard cinematograph film is used The sound record occupies a very narrow strip of the film about three thirty seconds inch wide on the margin and does not materially reduce the width of the picture

Phonofilm actual size; sound record at right

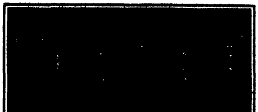
An especially designed gas-filled lamp called the Photion light, is inserted in the moving picture camera a short distance away from the usual objective lens The light from this Photion tube passes through an extremely narrow slit and falls directly upon one margin of the film This margin is screened from the picture itself so that only the light from the Photion falls upon it The film is driven continuously with an even speed in front of this narrow slit but with the usual intermittent step-by-step motion in front of the picture aperture

Now the light in the Photion tube is generated by the electric current which is passing through the gas enclosed therein The intensity of the light depends on the intensity of the electric current Therefore if a powerful telephonic current is passed through the Photion the light emitted varies exactly in accordance with the strength of the telephonic current at any instant. This light therefore, fluctuates in brightness hundreds of thousands of times a second in perfect rhythm with the telephonic current pulses, and varies in strength with the current

This telephonic current originates in the first place from the special microphone transmitter which is quite unlike the ordinary telephonic microphone, but serving the same general purpose This transmitter picks up the sound waves at distances of five to fifteen feet from the source of sound, transforming these sound waves into very weak telephonic currents. The audion amplifier is then used to amplify these weak currents 100 000 times to bring them up to sufficient strength to influence the Photion lamp in the camera Without the audion amplifier the entire arrangement would be utterly impractical because of the weakness of the voice currents

Thus we have three transformations—first, sound waves into electric telephonic currents then the amplification of these currents into light waves, and the registering of these light waves through the narrow slit upon the photographic film

The negative film carrying picture and sound record is now developed in the usual manner but using a special developer to bring out the details of the sound record Positive prints are made through a special printer to give the necessary light values for pictures and sound record. This positive print is then run through the moving picture projector machine. This is a standard projector machine such as is found in any moving picture theater A small attachment is added to this projector which in no wise interferes with its ordinary use This attachment includes a small incandescent lamp and a highly sensitive photo-electric cell, the latter being the invention of T W Case Between the lamp and the photo-electric cell passes the film as it travels through the projector machine The light from this incandescent lamp is concentrated upon a tiny slit similar to that above described in the motion picture camera. This light therefore passes through the sound record which has been photographed on the film, and on into the chamber containing the photo-electric cell The passage of the sound record across this narrow slit, therefore, controls the intensity of the light falling upon the sensitive cell.



Sound wave record of vowels, the phonofilm strip being enlarged several times

The photo-electric cell has this peculiar property—its electrical resistance at any instant is determined by the amount of light falling upon the cell Therefore, as the film travels across the slit and the light falling upon the cell made to fluctuate hundreds or thousands of times per second the electrical resistance of the cell is varied in strict accordance therewith.

Connected to this photo-electric cell is a small battery for supplying current, which current is therefore controlled by the light falling upon the cell and thereby made exactly to reproduce the original telephonic current from the transmitter when the sound picture was first recorded This new telephonic current, however, is extremely weak, and must be amplified, again through a series of especially designed audion amplifiers, until it is increased in power hundreds of thousands of times This powerful telephonic current then is passed through especially designed loud reproducers which are located behind or alongside of the moving picture screen upon which the picture itself is being thrown from the projector In this way the reproduced sound appears to come from the voice of the speaker or the musical instrument whose picture is being thrown upon the screen

By the phonofilm process the problem of synchronism is obviously completely solved The photograph of the sound and of the object are always together on the same film and always at the same relative positions thereon If the film breaks it is only necessary to insert a new piece equivalent in length to the part cut away, so that the synchronism is never impaired

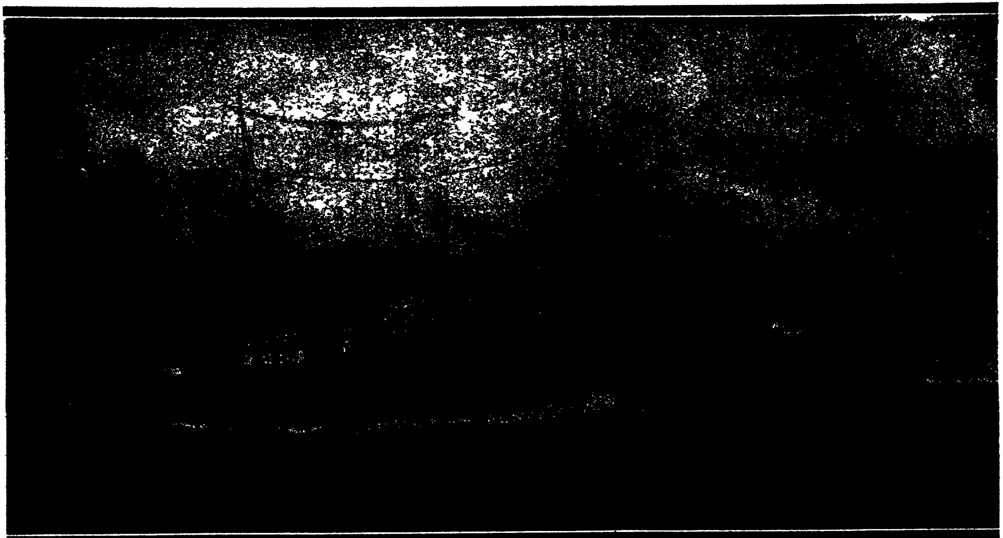
Throughout my work I have had in mind the making of the process thoroughly practical and commercial Only standard film is used and the reproducing attachment is designed for attaching to any standard projector

Spherical Aberration in Thin Lenses

THE images formed by lenses are imperfect and it is the task of the lens designer to compute lens systems in which the faults in the image shall interfere as little as possible with the uses for which the lens is designed The requirements for a telescope objective are different from those for a microscope objective while those for a camera lens are still different and vary according to the particular type of work which it is desired to carry out with the lens Lens designing is really an engineering proposition in which known scientific facts are applied to the solution of a definite problem in construction

Scientific Paper No 461 of the Bureau of Standards on the Spherical Aberration of Thin Lenses, for sale by the Superintendent of Documents Government Printing Office, Washington, D C., at 10 cents a copy, is a contribution to the meager stock of engineering data on the subject of lenses. It presents the data with reference to spherical aberration for a wide range of shapes of lenses for such indices of refraction as are likely to be met in optical designing. These data have been calculated from formulae which are well known, and the data so collected have been applied to the calculation of some of the simpler types of optical systems.

Instructions are given in this publication for calculating without great labor the curves for a telescope lens made from any sort of optical glass. These calculations are carried through for common types of optical glass, and the results are represented in the usual engineering fashion by curves. The paper contains a short discussion of the limitations and possibilities of the method of calculation used, thus furnishing the reader with general ideas of the way in which lenses may be combined for desired results.



Length, 556 feet. Beam, 55 feet. Draft, 13½ feet. Displacement, 7500 tons. Horsepower, 95,000. Maximum speed, 34½ knots. Battery, twelve 6-inch guns

NEW UNITED STATES SCOUT CRUISER "RICHMOND"—FASTEST OF ITS TYPE

THE naval program of 1916 included provisions for the construction of ten Scout Cruisers of 7500 tons displacement with 35 knots speed. They were to be the last word in ships of this class—larger, faster and more powerfully armed than any others. The urgent call for the construction of destroyers, however, caused the Navy Department to cease the construction of practically the whole of the 1916 program, including the ten scouts. Since the war the completion of these ships has been carried along as funds were available, and they are now beginning to go into commission.

The "Richmond," built on the Atlantic coast showed in her recent tests at full power in a run over the measured mile at Rockland, a speed of 34.2 knots, her maximum speed on a single run being 34.48 knots.

An excellent impression of the appearances of these fine vessels is given by the accompanying drawing, which shows the Richmond at full speed in a moderate sea. She is a decidedly handsome craft, and the vessels of her type have frequently been described as enlarged destroyers. As a matter of fact with a length of 556 feet a beam of 55 feet and draft of only 13½ feet she is as fine if not finer than our 35-knot flush-deck destroyers. If we remember rightly as at first designed the scouts were even more destroyer like in appearance than they are today the forecastle deck ending at the foremast and the main deck running from that point aft at the present level of the quarter deck. There was some question as to their girder strength and we believe the ships were stiffened by continuing the foredeck flush throughout the ship to abaft the mast. This added greatly to the strength and seaworthiness of the craft but the added weight brought down the speed to a contract speed of 33½ knots.

Steam is raised in 12 water-tube boilers oil fired of course and the power is developed on four shafts, each run by its own independent turbine. At the maximum speed on trial the "Richmond's turbines developed 94,000 horsepower. The main armament consists of 12 six inch rapid fire guns, which are grouped forward of the foremast and aft of the mainmast. On the fore deck, two 6-inch guns are mounted in a twin turret and just abaft of this are four guns, two on each beam, mounted in sponsons. The six after guns are similarly grouped.

A novelty in this ship is the adoption of the tripod mast type which has been well proved for many years in the British Navy. Its advantage is that it is stiffer than the lattice mast, and, therefore provides a steadier platform for the fire control station, which is carried at the top of the mast.

It is inevitable that 7000 tons equipped with between 90 000 and 100 000 tons horsepower and carrying a heavy battery of twelve, long-caliber, 6-inch guns must be built of comparatively light construction and it is questionable whether these cruisers are not a little too fine, both in their form and construction for the extremely trying work of scouting on the high seas and maintaining position in any kind of heavy weather that may be encountered. The war experience and the lessons which it taught seems to call for larger ships with heavier scantling and more rugged construction for this class of work. Therefore, since we are so terribly short of scout cruisers, Congress should provide the navy with 20 larger and heavier scouts, built up to the 10,000 tons limit imposed by the Washington treaty and armed with 8-inch guns. Such ships could keep station far ahead of the fleet, and do so under any possible stress of weather.

Naturally the question will be raised—what shall be done with our ten 7500-ton ships? The answer is to be found in the fact that, while we have the largest and most powerful destroyer fleet of any navy, its efficiency in battle would be greatly hampered by the fact that we have no flotilla leaders a type which the war showed to be absolutely necessary. Now these scout cruisers would be ideal for such work. Their speed would enable them to lead the destroyers into action and their powerful battery would be very effective in breaking up destroyer attacks, and in meeting and crushing by superior gun fire the largest flotilla leaders of other navies.

The lady beetle — Caterpillar infested with eggs — Digger wasp at its meal — Thread-waisted wasp attacking

Some of the insects that live by preying upon other insects, and the fashion in which they get their food

Insect-Eating Insects

Some Glimpses of the Eternal Struggle for Survival

By Dr. E. Bade

LIFE, which is a continual battle for existence, is fought without regard to rules. The weeds, whose seeds are carried by the fitful winds to the flower beds, fight against the cultivated flowers. They struggle toward the light, and attempt to suppress the desirable flowering plants. Everywhere in this strife of life, the ego, the personal "I" finds expression. The stronger often falls the victim of the weaker through thousands of artifices and ingenious devices, since mother nature is by no means embarrassed in finding new means and ways to arrive at its desired goal. In this respect she is the most prolific inventor, she tries ways which appear harmless enough, but the end is always the same, perpetuation of the species.

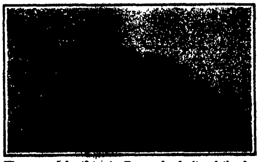
The obese caterpillar which sedately eats one leaf after the other, can hardly be distinguished from the surrounding green of the foliage. Suddenly it is frightened from its meal by the appearance of a thread-waisted wasp. The latter flies about it a few times, until it finally alights near by. The caterpillar senses danger, and lifts the anterior part of its body to a position of defense. Nervously the wasp runs about the leaf, the feeders vibrate, the slender abdomen is jerked up and down. Suddenly it lifts itself, hurls itself upon the caterpillar, and grasps it tightly by the neck with its strong mandibles. The poison sting is first placed under the neck of the defenseless larva, and a second sting is placed near the middle of its body, and the caterpillar and the wasp fall to the ground. The caterpillar is not killed by these stings, but it is paralyzed so that it cannot move about freely of its own accord.

The paralyzed prey is then carried by the wasp to some previously dug cave or cavity, and an egg is then deposited on it. When the larva hatches from the egg, it enters its involuntary host at once. Here the fatty parts of the caterpillar are eaten, and when the larva is fully grown and is about to pupate, the vital organs are eaten, and the caterpillar dies.

Other solitary wasps build nests of clay for their young. These are usually found under eaves of houses. Often more than one cell is joined together, and each one is filled with a paralyzed spider, fly, etc., which are eaten alive by the larva. Through the paralysis, the wasp provides its larvæ with a constant supply of fresh meat sufficient to last until they are ready to pupate.

The ichneumon flies (wasps) lay their eggs directly into the body of their prey, and often the eggs of other insects are provided with eggs of these wasps. Nearly every species of butterfly larvæ is preyed upon by certain special species of ichneumon flies. The larger species lay only one egg, of the smaller and smallest species, many hundreds of eggs are often deposited in one caterpillar.

Species of all insect orders fall victims to the rapacity of the ichneumon flies. The Braconidæ infest plant lice.



The ground beetle actually overhauls its victim by the use of "shank's mare"

They deposit an egg in the plant louse, and after a short while its abdomen will have become ghastly distended, and it now forms nothing more than a cavity for the wasp which will soon emerge.

The ground beetles, also, are mighty hunters, and they are of considerable economic importance as destroyers of insect pests. As exceptionally rapid runners, they chase and catch smaller beetles, and their murderous propensities lead them to the destruction of snails, centipedes, and others. They are liveliest in the hours of darkness, and when dusk falls they begin their insect hunt. Some run about all day long, while others remain half hidden on the ground between the fallen leaves, waiting for their prey.

The tiny lady-beetles (Coccinella) and their larvæ live almost entirely upon plant lice and scale insects and therefore deserve the most extensive protection. But besides these pests, others are also destroyed, the eggs of the potato-beetle being especially relished.

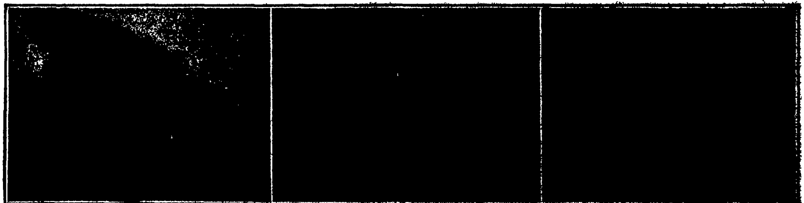
Beneficial, at least to some extent, are the robber-flies (Asilidæ) with the families Dasyllis, Leptogaster, Erax, and Asilus. The species of Dasyllis resemble the harmless bumble-bees, and this helps them to come close to their unsuspecting prey. On the other hand, it may also protect them from other insect-eating animals.

In general the robber-flies are strong, and dart quickly through the air. Like birds of prey they hurl themselves upon other insects, grasping them by the wing with their front legs, and carrying them to some convenient spot where they can suck out the vital fluid in peace. The beaks of many of these robber-flies are so strong that they can easily penetrate the skin of man, but they do not attack warm-blooded animals. Their prey consists of all kinds of insects; even the larva of butterflies are sometimes, though seldom, taken.

True dragons of the air are the various species of darning-needles. Like birds, they suddenly halt in mid air, hover quietly in the same place, turn quickly about, suddenly shoot vertically in the air, and dart away as if hurled from a gun, so rapid is their motion. In this, their restless flight, all animals which they can conquer, are caught. From out of the dancing mosquito swarms over ponds and streams, many an individual is suddenly carried away and eaten. The bee flies (true flies) and their allies, which visit the flowers, fall their prey. The fluttering butterfly is crunched by the cruel mandibles, and the clumsy, heavily armored, beetle is not safe from attack.

All the smaller insects are caught with the mandibles, the larger prey being caught and held by the feet. These are often torn to pieces while the darning-needle is still in flight, or it carries its prey to some resting place where it is munched at leisure.

The life of all insects in all their stages of development, with the exception of the resting pupa stage, is to eat. These animals can eat an inconceivable quantity of plant material in their short existence, which can be summed up in four words: eating, and being eaten. The profuse insect life is continually being destroyed in order to make life possible for a small minority.



The robber fly and his prey — Dragon fly on the wing — [illegible]

Three more of the most rapacious of the insects that help to keep down the [illegible]

Immunizing Cabbage by Natural Selection

How Nature's Standard Biological Process Is Adopted and Speeded Up by Man

By Robert G. Skerrett

HAVE YOU ever considered the cabbage as a factor in the American dietary? Have you any idea how prime a part it plays in our annual crops? If you have not, the statistics in the editorial note attached will give you some idea of what the ruin of this crop would mean to American agriculture.

More than twenty years ago the cabbage "patches" of Wisconsin were widely ravaged by a disease known to agriculturists as "cabbage yellows," and the loss ranged from 50 to 95 per cent in fields consisting of highly-fertile soils normally peculiarly suited to cabbage culture. The farmers and the State authorities naturally became much concerned, and steps were taken under the leadership of Dr L. R. Jones of the University of Wisconsin to determine the genesis of the malady and to find ways to eradicate it or to neutralize its hurtful activities. What has since followed is a fine example of scientific research applied to a relatively lowly problem.

When a cabbage is afflicted with the yellows in its more aggressive form, the vegetable loses vigor, becomes stunted, its foliage assumes a yellow, wilted look, and frequently dies long before reaching the heading stage. The promoting cause of the disease is a soil fungus known to the technicist as Fusarium conglutinans; and a soil so infected is termed "cabbage sick." Once the fungus has been introduced into the soil, it persists indefinitely, and we are told that ordinary crop rotations are of little avail in controlling the disease or in rooting it out. Other vegetables may be planted for a number of years and grow abundantly, and yet when cabbages are tried again the baneful fungus does its destructive work unchecked.

In 1910, the plant pathologists at the university's agricultural experiment station began investigations having for their goal the evolution of control measures. These included divers methods of treating seed, seedlings, and soil, and embraced likewise the testing of disinfectants and fertilizers, but without any encouraging results. Efforts were therefore made to see if a solution of the difficulty did not lie in perpetuating disease-resisting varieties or strains originating right on the infected soil. This was suggested by the fact that even in the "sickest" fields, when autumn came, occasional sound heads were found. Thus taking a cue from nature, profiting by self-developed immunity, the experts carefully selected the most promising of these surviving heads, seed was raised from them; and from this source was grown, in turn, on the worst soil available, an experimental crop. Those plants which remained sound and reached satisfactory maturity were saved as mother-heads for seed.

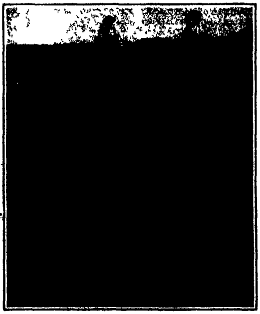
The consequence of this procedure was the production of Fusarium-resistant cabbages. But the task was by no means confined to propagating just a cabbage which would grow in infected soil and head despite the presence of the menacing fungus; the pathologists had to effect the evolution of types of cabbages suited both for storage, prompt marketing or conversion into sauerkraut by the numerous factories engaged in this business. This led, first, to experimenting with a cabbage of Dutch origin; and this work was brought to a climax when the so-called Wisconsin Hollander was developed, possessing both its normal [illegible] and a marked capacity to withstand the yellows.

[illegible] field trials were made with the Wisconsin Hollander in comparison with a non-resistant commercial [illegible] of the Hollander strain—both [illegible] in sick soils. Taking the average of [illegible] less than [illegible] per cent of the Wisconsin Hollander [illegible] Fusarium infection, whereas [illegible] of the commercial Hollander cabbages [illegible] with the yellows. These figures, [illegible] the whole story. The resistant or [illegible] only slightly affected by [illegible] having the yellows [illegible] while the [illegible] cabbages [illegible] early in the season [illegible] if they survived. Another [illegible] the year following, emphasized further the good work of Dr. Jones and his collaborators. That is to say, there was an average of only 6 per cent of yellows among the resistant or Wisconsin Hollanders whereas about 80 per cent of the commercial strains suffered seriously.

A warm soil encourages the virulence of Fusarium. The summer of 1919 was a hot and dry one, and during that period the relative immunity of the Wisconsin Hollander cabbage was put to a very severe test. Then, even the most resistant of this strain showed some indications of infection, in short, an average of 70 per cent of all of the Wisconsin Hollanders was affected; but as a rule the plants were just moderately diseased, and 80 per cent of the crop lived through the season. The non resistant "controls" or commercial Hollanders were, without exception, attacked by the yellows, and only one per cent were still alive at harvest time. Today, a strain of the Wisconsin Hollander has been brought into being which has not only the power of resisting Fusarium to a marked degree but it possesses certain desired physical characteristics, and reaches maturity earlier than the original stock. This strain has descended from a single head selected six years ago.

A similar procedure has been pursued in developing cabbages of other types so that they would be capable of withstanding or resisting the yellows even when grown on sick soil. Dr Jones and his junior associates have lately reported that "These resistant strains have proved resistant so far as tested in other States. Our experience gives us confidence that through further selection resistant strains suited to any localized conditions could be secured. It is our belief, therefore, that the cabbage industry can be permanently maintained in any section of the country, insofar as the Fusarium or yellows disease is a limiting factor, through the selection of disease-resistant strains."

FOR 1920, some 104,850 acres in the United States were planted in cabbage, and 940,525 tons of the vegetable were harvested. At average prices for the year, the value of this crop was $75,000,000. The importance of the cabbage-growing industry is made clearer when it is remembered that there are sections in which this constitutes the principal cash crop; and there are associated industries that stand or fall contingent upon a good cabbage harvest. Such is altogether the case in extensive regions of Wisconsin, and it is upon a situation that arose there, and the methods employed for dealing with it, that Mr Skerrett writes here.—THE EDITOR.



The kind of cabbage crop that can be raised when the plants are able to resist an attack of "yellows"

However, there seems a natural tendency on the part of cabbages of this sort to revert to the original type unless seed is continually obtained by selection from plants grown on soil impregnated with the troublesome fungus. In other words, the seed for healthy and immune plants should be drawn every now and then from vigorous cabbages raised in fields infested with Fusarium. By this method, so it seems, it will be practicable to maintain the standards so patiently reached after more than a decade of investigation; and thus seed may be successfully produced on any desired scale.

Besides Wisconsin, cabbage growing is carried on intensively in Iowa, Illinois, Indiana, Ohio, Pennsylvania, Maryland, Delaware, New Jersey, and some portions of New York; and the yellows have threatened to do much harm in all of these regions. The work of the agricultural experiment station of the University of Wisconsin has, therefore, a wide field of application. The specific varieties developed in Wisconsin would presumably not be best suited for growth elsewhere; but the Wisconsin method can be applied in other places for the development of varieties suited to local conditions.

The Loudest Voiced Bird

WHAT is said to be the loudest voiced bird in the world is the bell bird, which is found in both South America and Africa. The naturalist, Waterton, says of this bird, which is also called the Campanero, "Its song is loud and clear like the note of a bell and is audible at a distance of five kilometers. No song or sound of any other feathered forest dweller rouses so much wonder as the 'tolling' of the Campanero. A single stroke of the bell is heard and these notes follow each other at intervals of about a minute."

The bell bird is pure white in color and about the size of an ordinary pigeon. Its head is adorned (or disfigured) by a singular horny excrescence, which is lifted for a distance about seven centimeters, while the bird is singing. It is this movable horny structure which is connected with the roof of the mouth which provides the resonance which enables the bird to produce its singular bell-like note. Every one who hears its remarkable tone for the first time is convinced that it must proceed from some neighboring church tower or campanile. It is a curious fact that the bird utters its song only when other voices are silent.

Geography and Intelligence

IN a recent address before the Section of Geography of the British Association for the Advancement of Science, Dr Marion Newbigin discussed the subject of Human Geography First Principles and Some Applications. Geographers are agreed, Dr Newbigin said, that there is a definite human geography, but little attention has been given to the problem as to the precise way in which man's response to environmental conditions differs from that of animals. Since man once ran into a number of species—or even of genera—it is obvious that there was once a time when there was no distinctively human response, when adaptation led to specific differentiation, just as it does among animals. But since all living men now belong to one species, it is clear that this time has passed. Its passing appears to be associated with the fact that growing intelligence meant that the barriers of distribution which limit the movements of animals ceased to function.

Obviously, this in its turn might have meant that human evolution had stopped, that man had ceased to be adapted to any particular habitat because fitted for all, were it not that the factors of fixation and isolation, so important in the case of the lower organisms, began to act in a new way. With the growth of cultivation, communities became fixed to particular areas, and if the isolation was sufficient to ensure the necessary continuity and protection during the early stages, a communal as distinct from any individual adaptation appeared. The second part of Dr Newbigin's address dealt with applications of these general principles to the chief foci of civilization in Europe and the adjacent lands. Thus the causes which promoted the origin, growth, and decay or modification of the successive cultures of the great river valleys, of the Mediterranean seaboard, and of the forest belt of Western Europe were considered, and the peculiar difficulties encountered in establishing stable communities in the steppe lands of Eastern Europe discussed briefly.

Diamonds from Guiana

How the Precious Sparklers are Recovered from the Gravel

By Frank Munro

Sorting the residue gravel, dumped from the sieve, for diamonds

THE ROMANCE of the diamond—fascinating not alone to the devotees of luxury and splendor, but also to the serious and practical man of science, and even to workaday folk—is having some interesting and illuminating chapters added to it by William J La Varre, an American mineralogist and explorer He has been down near the equator, to British Guiana—shrouded in its jungle haze, has lighted up that country with the sparkle of its own gems, and has given the hope of wealth, to those, at least, who will intelligently work for it, and take the dare of mosquitoes, malaria and a generally trying climate

Even the primitive methods of the unskilled natives are yielding large returns, but Mr La Varre feels that with the introduction of modern ideas and machinery a new El Dorado will be revealed. The promise and potency is in his bringing back to New York, some time ago, a cluster of diamonds of 150 carats, recently he returned with one of 500 carats, also the largest single stone, it is claimed, ever found on this continent, the "Kurupung," of more than 80 carats Incidentally, it may be said he has gathered specimens of birds and animals for the Smithsonian Institution

The new region of mineral wealth lies along the Mazaruni River and its tributaries, and is in the jungle about 140 miles from Georgetown, the capital of British Guiana It has been but scantily prospected by gangs of natives and half-breeds, who have received the name of "pork knockers," from the fact that their ration consists largely of pig, and they literally beat about the bush Civilization has laid a very gentle hand upon the people up to the present Now, apparently, it is about to awaken them with the crackle and crash of the steam shovel

Despite industrial deficiencies, these pork-knockers have for some years been shipping small lots of diamonds to England. The men go into the bush in groups or alone, scraping the gravel from the shallow creek beds, or perhaps digging one or two feet into the banks. A happy-go-lucky crowd are they, of Dutch and Indian or Negro lineage. They gather at Bartica, the outermost point of civilization, and wait for a prospecting party that may require extra paddlers. Sometimes they "connect" with a supply boat going to the trading posts in the mining districts. The trip takes several weeks, and is "worked out" by the voyageurs. On leaving the craft they receive a bonus in the shape of a week's supply of pork, rice, salt fish, etc

The native prospector usually begins his work in a shallow creek bed. The implements consist of an axe, shovel, pick, bucket and a sieve to separate the diamonds from the gravel.

"A party I once chanced upon," says Mr La Varre, "was illustrative of the average group and method one might see in the bush. A negro (giant in size and clad only in a loin cloth) stood knee-deep in the creek, and with a long-handled shovel filled a bucket with small gravel. The boy who held the bucket carried it to an old man, who did the 'scientific' part of the job, that is, the jigging of the gravel in the round sieve. Diamond production depends largely upon the jigger If he is careful and knows his work, there will be no loss.

"The old man was astride a pool about three feet wide and two feet deep. By a series of calculated motions he attempted to form a centrifugal force which would serve to center the heaviest material in the bottom of the sieve, and as diamonds are the heaviest of the pebbles, they naturally are the first to respond to the movements. Where diamonds are found there are likely to be also tin, carbon and pulsite, mixed with quartz. These minerals are heaviest, next to diamonds, and are therefore also sent to the bottom.

"The sieve, filled with gravel, was placed in the water and turned from left to right while in a level position Then it was quickly lowered and raised, and shaken from side to side. Finally it was swung around while tilted. After a few moments the man scooped up the top gravel and threw it away, then he added new gravel to that left in the sieve, and repeated the operation over and over for an hour

"By this time there was left in the sieve only black carbon, brown pulsite, and a small center of tin, in which the diamonds, if any, were to be found. The sieve was now turned upside down on a piece of level canvas stretched on the ground by means of pegs. From the middle of the outermost residue the prospector picked out a small but perfectly shaped diamond of one-half carat That stone I have at present as a reminder of the first time I ever saw a gem taken from the soil"

The "long Tom" in action, washing gravel and sorting out large stuff preparatory to jigging

Somewhat in contrast to this, although essentially primitive, has been the procedure at the mine known as Le Desire. It is located in the alluvial deposits in an old bed of the Mazaruni The river had changed its course since depositing a 30-foot pile of diamond-bearing gravel, and giant trees had grown up. These were cut down, and furnished the beams for the shafts. Here the gravel is washed in "long toms," and several jiggers are employed.

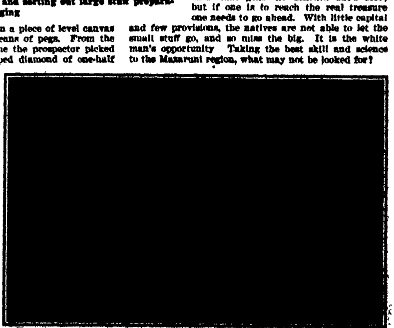
The "toms" are troughs placed at the outlet of a dam in the creek In each are inserted three sieves of different-sized mesh. The gravel is dumped into the upper end of the trough and washed down by the pressure of the water coming through from the dam above. The larger stones and gravel are kept back and thrown away After passing through the "long tom," the gravel of uniform size falls into a rectangular flat sieve that is suspended by four chains from a scaffolding in such a way that the pool below just covers the bottom of the sieve. A man stands in this water and shakes the container This gives the finishing touches to the washing. Then the gravel is brought to workers who "jig" it in large square boxes.

Diamonds are easily identified in the raw state by their peculiar sheen and shape, but if there is any doubt about the stones, the matter can be decided by subjecting them to pressure between two knives. Almost anything except a diamond can be crushed. In color they vary from white to pink, blue, yellow, green, and black. Their shapes range from spherical to flat. Some "raw" stones from the Mazaruni region are so perfect in shape and color that it is difficult to believe they have not been cut and polished by machinery.

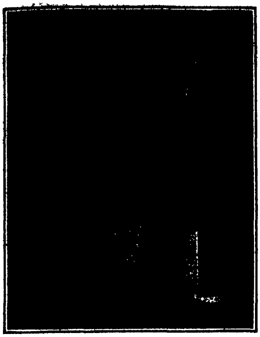
The supposition is that the diamonds which are found in the creek beds are the alluvial deposits of a primary formation, that is, they come directly to the stream gravels from the breaking-up and erosion of the rock in which they were formed. Alternate changes in temperature (heat by day, chill by night) will sometimes accomplish this, the mass having received an initial impulse or direction All this means easier mining and a quicker tracing of the source. The shape, and the markings on the Kurupung already referred to, give evidence of its history an eighth of an inch groove on one octohedral face could only have been caused by the continuous rubbing of loose material across that side when it became exposed on the surface of the rock in which it lay firmly imbedded.

When Mr La Varre, on one of his earlier trips of exploration, visited the Mazaruni region he found that the natives, ignorant of the true value of these alluvial diamonds, were using them frequently for such household aids as potato-scrapers! Now the bort, or chips, find their way largely to British manufacturing plants, where highly polished surfaces of steel are required.

The one thing the native prospector has lost sight of is the fact that diamonds come from central sources, and that creeks in which they are found lead to those sources. It is hard to push on when one finds that gems lie beneath one's feet, but if one is to reach the real treasure one needs to go ahead. With little capital and few provisions, the natives are not able to let the small stuff go, and so miss the big. It is the white man's opportunity Taking the best skill and science to the Mazaruni region, what may not be looked for?



Entrance to a diamond mine, showing piles of washed and sorted gravel



Dayton's latest landing signal for the night-flying pilot

A Beacon for Aviators

A MOTOR truck whose engine supplies electric current for lighting a powerful searchlight, in the form of a beacon for guiding aviators when flying at night, was recently demonstrated at McCook Field, Dayton, Ohio. The same engine that furnishes motive power for the operation of the motorized vehicle also is the source of current for illuminating the brilliant searchlight.

The light radiated by this new type of beacon is of high intensity—800,000,000 candlepower—and the reflector for spreading the rays of light measures thirty-six inches in diameter. By the illumination radiated from this powerful searchlight, when stationed at a landing field, the aviator when navigating the air after nightfall should be enabled to locate the landing field from a distance of 75 to 100 miles. Similar beacons are employed on battleships when at sea, but this is the first time that such a searchlight has been adapted to purposes afield.

When the United States Post Office Department is contemplating the innovation of the carriage of postal matter by aircraft at night the necessity of marking landing fields by some form of artificial illumination is apparent. The location of powerful beacons at intervals of 100 miles along the route over which the mails are to be transported is the most common suggestion as a way of solving the problem of night-flying of airplanes. Then, too, the navigation of air-going machines after nightfall is becoming more common for general purposes as aircraft development seeks a foothold in America. Some system of marking the landing fields by searchlights will have to be devised, if night-flying is to become a practice, and the beacon illustrated is a long step in the right direction.

The Gipsy Moth and Dead Trees

THE gipsy moth has now spread over a large part of New England and is in position to continue its march over the adjacent states, and the rest of the land. During the past two years it has moved westward, fifty miles. At the rate of 25 miles per year, the death of our trees, especially the oaks, can be predicted by arithmetic unless help arrives in time. To combat this threat the Federal Government has been spending about $150,000 per year, but this has only retarded the spread of the moth. Those who have seen the chestnut trees in the East standing out in the forests like gaunt, stark skeletons as the result of another destructive agency which rapidly spread over whole states, will best be able to envision the oaks, a more numerous species, silhouetted against a mass of green, dead. On Cape Cod, where the moth has been active, 90 per cent of the oaks are dying.

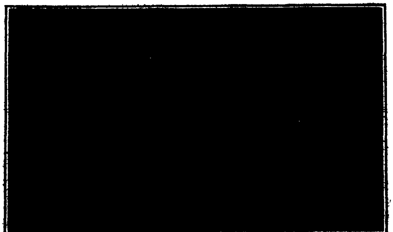
As the pest spreads, it will be the turn of the New York State oaks to die next, unless something is done, for the moth has already established itself along 75 miles of the eastern border of that state. Stopping the moth is like stopping the spread of a grass fire in a strong wind. If begun in time it can be done. If not, it must burn itself out. The fire spreads from all sides of the circle, but the fire-fighter can work from only one place.

Pursuing this analogy, it has been proposed to establish a barrier zone from Long Island Sound to Canada, having a width of 25 miles, beyond which the Gipsy Moth shall not be allowed to establish itself. This really amounts to applying the same exterminating measures to a narrow strip as would be otherwise necessary to apply to the entire area infested.

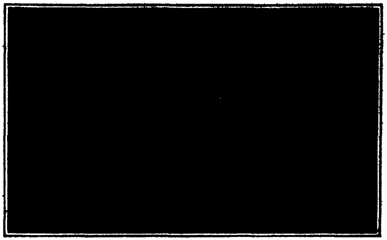
Owing to the prohibitive cost of establishing control of the moth in the forests, except in a limited belt as a protective or defensive strip, it is nearly impossible to grow many of the most valuable trees to timber size in badly infested areas. Therefore these may produce little else than scrub and brush. A failure to recognize the possibilities of a barrier zone, and to provide means for combatting the ruinous pest within its limits may expose a large proportion of the country to the ravages of an extremely injurious forest insect just at a time when every effort should be made to conserve and increase our forests and forest products. Within such a limited area, it is merely a matter of concerted effort, by burning, spraying, etc., to suppress the moth entirely.

An Effective Barrier for Automobiles

SAN FRANCISCO, the city of high hills and terrific grades, has solved the problem of getting the trolleys across one of the stiffest of these eminences, Twin Peaks, by boring a tunnel beneath the ridge. This tunnel is intended only for the trolleys but its entrance is so situated with respect to the automobile road that numerous automobilists have, in perfectly good faith attempted its passage—aside from those who, in bad faith, have preferred going through to going over. Unfortunately, there is not clearance for a car and an automobile in the tunnel, and the chauffeur who meets a trolley half-way through has to back out, to everybody's great inconvenience. The trolley company finally hit upon a novel expedient for keeping the intruding automobile out of the tunnel—the concrete ditch shown in the picture at the lower left corner of the page. The ditch is three feet wide, and, with the trolley rail of upstanding T-form, its negotiation by a car or truck would be quite out of the question, and no chauffeur would attempt it.



The concrete ditch that keeps automobiles out of San Francisco's trolley tunnel



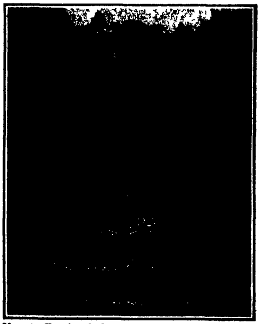
The mirror that gives the motorman a last look at his trolley wheel before entering the tunnel

A Mirror in a Novel Place

THE ingenuity of San Francisco's tunnel builders did not stop with the automobile bar described in the preceding column. The tunnel is dark, and it would be extremely difficult to replace the trolley wheel on the wire, if it should come off. In the straight run through the tunnel the possibility of its coming off is slight, but in crossing the connections at the mouth of the shaft this possibility is fairly large. So the little mirror illustrated has been installed, and the motorman is expected to assure himself that the trolley wheel is properly seated before he enters the bore.

The Talking Traffic Lamp

AUTOMOBILISTS whose driving takes them into the surburban towns of New Jersey have been treated during the past few months to a new model of traffic signal which they have found to give admirable service. The idea behind this new signal is two-fold. First, it uses flashing colored lights to attract the driver's attention, rather than a fixed light. These flashing lights can be seen for a mile or more when the configuration of the road permits, and hence the driver has ample warning of the danger spot. Second, when he reaches the signal he is left in no doubt as to what he should do, what the local police regulations demand that he do, etc. At a sufficient distance from the signal to obviate the necessity of stopping to make them out, he finds that the lamp or the post or the base carries full instructions—words, arrows, or whatever else be necessary. These lamps are being installed in increasing numbers at danger points and traffic centers. In the latter instance, street names and destination signs take the place of the arrow and the admonitory lettering. Both by day and by night the motorist can read all this as he approaches, without stopping.



New traffic signal that is easy to find and easier to read

Carrier Current Telephony

Guiding Radio Telephony over Existing Telegraph, Telephone or Power Lines

By B. R. Cummings
Radio Engineer of General Electric Company

IT IS a matter of common knowledge that a single electrical conductor can be made to be a part of two or more electrical circuits and function in each circuit simultaneously. It is possible, for example, for a single conductor to carry both alternating and direct current, or two or more alternating currents of different frequency characteristics, simultaneously.

These currents do not exist independently in the conductor, however, and at any instant the current flowing is the sum of all component currents.

While the current in the conductor is the resultant of individual currents, it is possible to attach to such conductors suitable groups of apparatus, so that one group will respond to the current of one characteristic, and the other to that of the other characteristic.

This fact is somewhat analogous to transmission by radio at different wavelengths. The ether which is the medium which conveys radio signals, is carrying a very great number of independent communications simultaneously, although we are able to adjust our radio receivers so that we can select signals at one frequency, and, with sufficient frequency separation, hear nothing that is being transmitted at other frequencies.

So that, while signals carried by wire are transmitted by conduction rather than by radiation, a conductor may be made the medium whereby a great number of signals, having individual characteristics, are carried simultaneously, and each can be received by apparatus which is adjusted to select any of the incoming signals.

This phenomenon has found growing application in communication systems. For example, if a group of wire lines between two points are being used for telephone communication to their capacity, additional communication can be provided between these points either by erecting new lines, or by making the existing conductors carry additional load of characteristics differing sufficiently from those of the existing load to permit its independent reception. The choice between the two methods becomes a question of economic selection.

Similarly, if communication is desired between two points already connected by lines used for another purpose, such as for example, a transmission line for the transmission of power, it is possible to utilize these lines for telephone communication, rather than erect an independent line for this purpose.

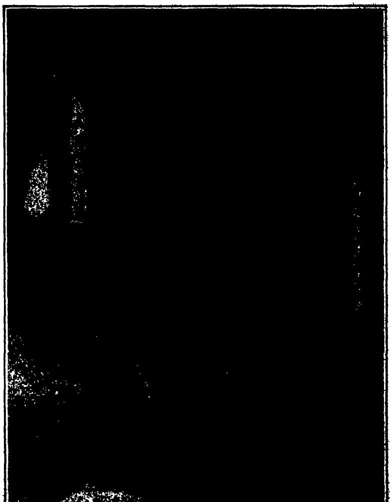
The method used to superimpose telephone communication on a line already in use for the transmission of speech by the usual methods, or for the transmission of power, lies in generating an alternating current of rather high frequency, modulating it in much the same manner as the output of a radio transmitter is modulated, and coupling the generator to the line. At the receiving end, apparatus is used which somewhat resembles a radio receiver. This is also coupled to the line, and tuned to the frequency of the communication current.

The system of communication which results, is known as "Carrier Current Telephony," a name derived from the fact that the communication is carried by the high frequency source rather than directly, as in the case of the usual telephone line.

Since radiation is almost directly proportional to frequency, and since the frequencies used for carrier current work are comparatively low, a line utilized for carrier current communication radiates very little energy, and communication is carried on primarily by conduction. Such transmission, therefore, is fundamentally different from transmission by radio.

Carrier current communication has advantages over wire telephony in addition to the fundamental in that it can be applied to existing lines. For example, it is customary for power companies who maintain long transmission lines, to provide for telephone communication between their various stations and sub-stations, by running wires either above or below the power lines. Such procedure, while undoubtedly serving its purpose to a certain extent, is subject to failure from a number of sources.

For example, the entire line from one station to the other must be maintained intact for communication to be maintained. The fact that the line is exposed to damage for a great many miles makes it probable that it will be brought down by severe wind or hail storms, putting the telephone service out of commission. The fact that it runs this distance also exposes it to the hazard of becoming crossed with wires in the transmission line in the event that one or more of them should fail.



Typical carrier current telephone station for handling [illegible] conversations over high-power transmission lines

For carrier current telephony over transmission lines, the exposure to such failure is appreciably reduced. The carrier current telephone equipment is coupled to the transmission line by means of a capacitance in one form or another. The maximum exposure offered in such installations, is that of one or more coupling wires strung for a length of 1000 feet beneath the transmission line. This is necessary at both the transmitting and receiving station. The physical exposure, therefore, is reduced to a negligible minimum, when compared to the total length of the line. The reduced exposure of the carrier system also results in far greater freedom from disturbances which are usually encountered in telephone lines erected adjacent to transmission lines. This refers to induced noises, lightning and atmospheric disturbances.

While carrier current telephony requires, for successful operation, a closed alternating current circuit, such a circuit may be maintained under conditions which would be fatal to a direct current circuit. For example, one or more of the conductors of a transmission line may be severed without destroying communication, since the alternating current circuit remains intact so long as there is a single conductor left intact, or so long as any opening in the line has sufficient capacity associated with it to keep the alternating current circuit intact.

Carrier current telephony, however, will not be successful on a system if the line is completely opened either by switches or by all of the conductors in the system becoming severed, unless additional so-called "coupling equipment" is provided for bridging the point at which the circuit is opened. This provision is made applicable at points where the circuit is intentionally opened at intervals such as at switching stations or at circuit breakers.

If communication is required by the two points under the most severe conditions, such as the complete transmission line being down for a considerable distance, straight radio is the only sure solution. One of the greatest advantages of carrier current telephony, however, lies in the fact that it is not radio equipment and the stations are not radio stations and that, therefore, it is not necessary to obtain an operating license from the Department of Commerce and keep an operator on watch at all times.

Carrier current telephony on power lines can best be justified when the system is erected. If carrier current is used, no provision need be made for the erection of telephone lines. Since such provision is a matter of considerable cost, particularly in cases where provision for a telephone line would mean the erection of towers several feet higher than would otherwise be required, it is far more economical to install a carrier current communication system.

Successful tests of carrier current, as a means of communication between moving street cars and the power station on the Third Avenue Railway of New York City, were recently completed. This is the first time that a moving trolley car has been able to keep in constant communication with headquarters and marks a new advent in this new science.

At the suggestion of the Third Avenue Railway, this new use of carrier current was tried. A transmitting and receiving set, similar to that used in any radio broadcasting station, was installed in the Brook Avenue sub-station in the Bronx and a similar set was installed in one of the street cars. The messages, as transmitted from either the car or the sub-station, [illegible] through [illegible] trolley wire, thus [illegible] of signals. Other advantages of carrier current over ordinary radio were the [illegible] of signals. Persons who listened [illegible] from the moving car or the power station [illegible] say [illegible] conversation [illegible]

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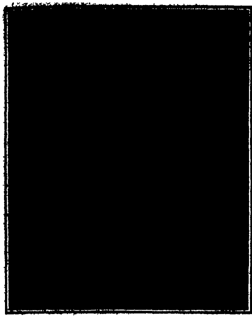
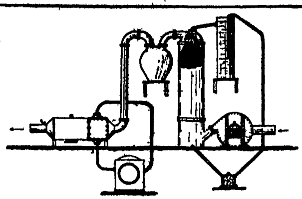
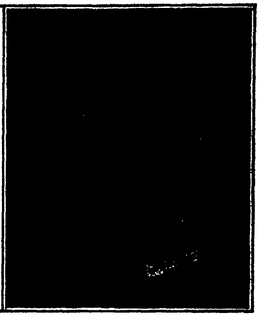






Left: Portable style of the apparatus that gives adequate ventilation in the absence of any new air. *Center:* Diagram showing the modus operandi. The foul air enters at the right, as indicated by the arrow, passes through the washing tower and chemical cleaner, and issues forth in a clean and fresh state at the left, as indicated by arrow. *Right:* The outfit in stationary model for ventilating a chemical factory

How a Berlin doctor has made it possible to have clean, breathable air under all conditions

Making Old Air Better Than New

By Dr. A. Gradenwitz

WHATEVER the organism produces by its normal respiration and perspiration, carbonic acid and water vapor, mixed with morbid germs and the dust raised by a multitude of operations and made all the more offensive by an often uncomfortable rise in temperature; whatever industrial processes turn out in the way of unhygienic dust and bad odors, all call for a periodical renewal of air. Now, what can the "fresh" air derived from inhabitated areas, especially in densely populated cities, be expected to yield for ventilation purposes, filled as it is with similar impurities in addition to the dust and smell left by passers-by and vehicular traffic? Still, for want of better, we had so far to be satisfied with this outside air, both in opening our windows for the sake of ventilation and in connection with those ventilation plants admirable from other points of view.

A medical practitioner living in Berlin, Dr. Albert Wolff, has devised a remarkable new scheme enabling the air in a closed room, within a minimum of time, to be perfectly regenerated, eliminating even the most offensive odors, any trace of dust and morbid germs, disposing of any surplus carbonic acid and water vapor, as well as lowering its temperature in summer and raising it in winter—all without any supply of outside air. The process has now been developed to a commercial stage and, but for economical conditions at present prevailing in Germany, would long have been in operation on a large scale.

The process consists of three consecutive stages, the first of which is optional, the remaining two compulsory. Whenever, in fact, dust of an especially coarse description is raised in the rooms to be ventilated, an incombustible mechanical filter should preferably be inserted in front of the apparatus, thus reducing its wear and tear. This, of course, is quite independent of the process proper, the underlying principle of which can be stated as follows:

The air to be regenerated is, by a combination of specially designed pumps with a washing process, whirled around into minute bubbles, so as to appear like smoke or mist, in the water of a washing tower. After being thus spread over an area as great as possible, the air, in the third stage, comes into contact with an electro-colloidal solution, automatically supplied from a regenerating reservoir, and which exerts on all oxidizable matter an extremely energetic oxidizing action. The apparatus is placed in an adjoining room and draws the air in from the outside. The admission of air takes place at the floor, care being taken [illegible] in spite of a [illegible] of air per hour and heavy [illegible] temperature between the [illegible] and [illegible] openings.

The oxidizing solution is obtained by the action of ozone on metallic chlorides. The reagent, after escaping from the lower part of the washing tower, is automatically regenerated in a continuous cycle, so as to be used over again. Any possibility of free ozones entering the ventilation air and thus irritating the organs of respiration is absolutely excluded. The air escaping from the top of the washing tower passes through a drop-catcher and across heaters, enabling its temperature and moisture to be adjusted at will.

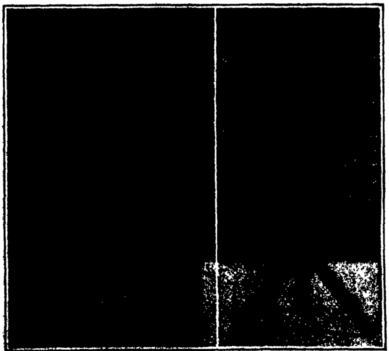
The whole of the oxidizable matter is submitted in the washing tower to the continuous action of nascent oxygen. The most offensive odors are totally absorbed by the apparatus. Morbid germs from the buccal cavity, according to tests made at the principal Berlin hospitals, are annihilated completely. The most remarkable feature in this connection is that on account of the instantaneous destruction the apparatus always is sterile and never, like other filters, becomes a focus of infection.

The carbonic acid of the entering air is, by a special chemical process connected with the filling material, reduced by degrees. An apparatus dealing with about 800 cubic meters per hour takes up a space of about two cubic meters and requires an expenditure of about three kilowatts per hour for its operation, inclusive of the cooling effect.

The very finest dust particles suspended in the air and on which all filters so far in use had been without any effect can thus be disposed of. The process will prove especially invaluable in the case of industrial plants the operation of which is connected with the production of offensive smells. Refrigerating chambers will derive great profit from its use, while the air in hospitals can by means of the new process be controlled at will, so as to contain only disinfected air and medicine. During the war, use has already been made of the process for the aseptic treatment of wounds without any dressing in Berlin military hospitals. If economic conditions at present prevailing allowed of the expense, it would be possible without any trace of draught to ventilate hospital wards with an individual atmosphere corresponding to any special conditions.

An additional advantage is that, wherever required, any valuable material can readily be recovered from the air thus treated. This possibility has already been made use of in the chemical industry.

This German device presents an interesting development in ventilation problems. Heretofore, the usual idea has been to expel foul air and take in fresh—or so-called fresh—air from outdoors. There have also been devices for producing ozone for the purpose of destroying bacteria in the foul air, but, as pointed out, this pungent gas irritates the lungs. In crowded districts the problem of good air is a pressing one.



Recently developed "spectrometer" for applying the principles of spectroscopy to commercial analysis

Chemical Analysis With the Spectroscope

SEPARATION by ordinary means of sufficient quantity of an impurity to determine its nature is often a lengthy process. With a spectrometer, on the other hand, the presence of spectral lines characteristic of a given impurity may be detected at once. In many cases as little as one part in 100,000 can be observed instantaneously and without error. In some cases, quantitative determination is even possible, the time required for the disappearance of the line in the arc being a measure of the amount of the impurity present.

Improved apparatus for such determinations as these is recently on the market. It is similar in appearance and size to a microscope, as our views show, and takes no more room on the table. The telescope has in its eyepiece a slit and a small autocollimating prism for introducing the light. After passing through the object glass the rays of light proceed to the 30-degree prism. This is silvered on its back surface, and the light retraces its path through the object glass to the eyepiece by means of which the spectrum is viewed. The prism is mounted on a table provided with a lever, and is rotated by means of a micrometer screw pressing against the lever to which screw is attached a drum, on which is engraved the scale of wave-lengths. The index moves along a helical slot

What Makes Glue Stick?

Some Studies of the Roles Played by the Wood and by the Adhesive

By Eloise Gerry and T. R. Truax

Of the staff of the Forest Products Laboratory, Madison, Wis.

WOOD, because of its cellular structure, can be glued more easily than many other materials, such as glass or metals. The adhesive is forced into the hollow air spaces, the cell cavities or the pores of the wood, where it becomes firmly anchored. When a good glue has become set, it is possible to shear or tear apart the solid wood without breaking the glue joint.

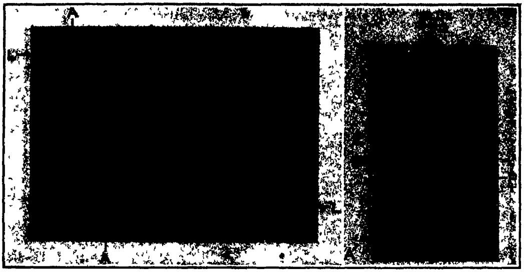
The accompanying pictures of plywood as seen under the microscope, illustrate the appearance of some veneers glued together with the grain of alternate plies running at right angles to each other. The manner in which the glue enters woods with different types of structure is shown.

The material here presented was obtained in the course of investigations now being carried on at the United States Forest Products Laboratory to determine the effect of various isolated factors, such as wood structure, pressure, length of assembling period, moisture content, and temperature of the wood, upon the results secured in gluing different species of wood with different kinds of glues.

Glues which are commonly used as adhesives for wood may be classed as (1) animal and fish glue, (2) vegetable glue, (3) casein glue, and (4) blood albumen glue. For a comparison of different glues as to manufacture, properties, and uses see Report No. 66 of the National Advisory Committee for Aeronautics, entitled "Glues Used in Airplane Parts," by S. W. Allen and T. R. Truax.

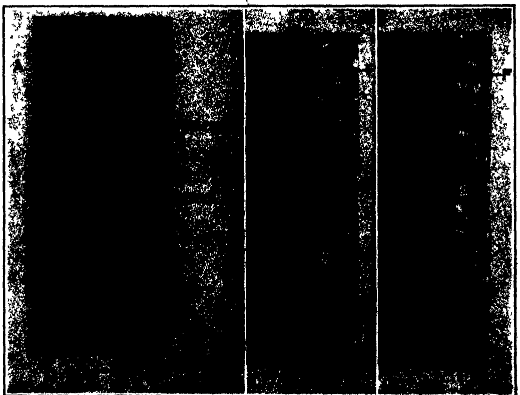
In all the woods examined it was found that the various glues did not penetrate the cell walls but entered only the exposed openings of the cell cavities. As is evident in one photograph, where two pieces of veneer are glued at right angles, the manner in which the glue penetrates is chiefly due to the fact that the veneers were cut in such a way that a very slight cross grain (as it appears under the microscope) is present. This permits the glue to penetrate the wood through the cell openings thus exposed (*A*, in the photograph) which extend away from the spread surface at a slight angle. If the cross grain is pronounced, however, it weakens the veneer and also tends to permit the glue to penetrate to the outer surface of the panel and produce undesirable staining. At *B*, on the picture, is shown the penetration as it appears on the end grain. From this it is apparent that the diagonal penetration of the glue may extend some depth below the spread surface. Were the manner of its entrance not realized, the appearance of the penetrated pores at *B* might mislead one into thinking that the glue had penetrated directly through the cell walls from the spread surface, instead of only through cavities, which at some point are in contact with the spread surface, as *A* to *C* in the left view of the bottom group.

Provided a continuous film of glue is present, and sufficient penetration is obtained, the thickness of the glue line in the joint may vary considerably without appreciably affecting the strength of the union. This is illustrated by the fourth and fifth views, showing joints of substantially equal strength. On the other hand, air pockets (*A*, in the first view) or undue forcing of the glue out of the joint may materially weaken the panel. It is not necessary that the glue penetrate for a long distance into the wood, if only a sufficient anchorage is obtained all the way along the joint surfaces. Numerous relatively shallow glue pockets, such as are made by the penetrated fibers at *F*, in our last photograph, are preferable to a few deeply penetrated, but isolated, cells.



Left: Three-ply soft pine glued with blood albumen glue. Only enough pressure was applied to keep the veneers in contact. Note the wide glue lines, *L*, and air pocket, *A*. *Right:* Spanish cedar glued with blood albumen glue. There are *few pores*, *P*, and they are rather isolated. Penetration of the fibers, *F*, therefore greatly strengthens the joint

Typical glued joints of different characteristics



Left: Blood glue joint between basswood veneers. The glue has penetrated chiefly through the pores, *P*, openings larger than those of the surrounding fibers, *F*. This is a typical wood of easy penetration. *Center:* Birch glued with blood albumen glue under pressure of 50 pounds per square inch. Note wide glue line, *L*; penetration is chiefly in the pores, *P*, with little in the fibers, *F*. *Right:* Same combination, but glued under 200-pound pressure. Here we have a narrow glue line, with good penetration in fibers as well as pores

Some more details of glue penetration under different conditions

Relatively large cavities, such as those of the pores or vessels of hardwoods, as in red oak, mahogany, or birch, are penetrated with considerable ease, especially when they are not closed by tyloses or gums. Hence, for the most part, when abundant pores are present, the longitudinal surfaces of relatively coarse-textured woods can be glued very readily. In joining end-grain surfaces, on the other hand, large, open pores tend to absorb too much glue and cause a starved joint, unless special precautions are taken. The evenness of the distribution and the abundance of the pores, especially on longitudinal surfaces, are very significant factors in successful gluing.

From a standpoint of the number and distribution of pores, it is obvious that with the same treatment basswood could be glued more easily than oak, where surfaces practically lacking in pores may occur. If the pores were the only means for holding the glue, Spanish cedar and black walnut would be found relatively difficult to glue. The general penetration of the fibers, *F*, in our second view, is a significant factor in such woods, however, and is to some extent necessary if a strong joint is to be obtained.

Woods having fine texture, or a large proportion of cells with small cavities, may require different treatment, especially with glues of relatively high viscosity. The fibers of white oak, hickory, black walnut, and ash, are examples of wood structure where special attention is usually necessary in order to force the glue into the smaller cavities. Our fourth and fifth figures afford a comparison of the penetration occurring in the fine-textured portion, made up chiefly of the fibers *F*, in birch under different pressures. In this case, however, the additional penetration of the fibers seemed to be unnecessary, since the anchorage of the glue in the numerous pores made a joint practically as strong as the wood. In contrast to the [illegible] pores of birch,

(Continued on page [illegible])

Solders for Aluminum

CIRCULAR No. 78 of the Bureau of Standards entitled "Solders for Aluminum" has recently been revised. It will soon be available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy

Most of the metals commonly used in solders, except magnesium, are electro-positive to aluminum, so that any metals used in making a soldered joint of aluminum act electrolytically in the presence of moisture as positive galvanic poles accelerating the corrosion of the aluminum. Magnesium cannot be utilized advantageously even though it is electro-negative to aluminum because the metal disintegrates rapidly in the presence of moisture. Therefore, soldered joints of aluminum which are to be exposed to moisture should be protected against corrosion by paint or varnish Various compositions of zinc-tin and zinc-tin-aluminum solders give the best results.

The tensile strength of a good aluminum solder is about 7000 pounds per square inch, because those with higher tensile strength usually have such a high temperature of complete liquidation that they are unsuited for soldering. Usually the strength of an aluminum soldered joint depends upon the type and workmanship.

A Draw Bridge Which Slides Diagonally

THERE is something decidedly different about the draw bridge shown in the accompanying illustration, even though it has been in use for several decades. Because of the limited space available, this bridge, which spans the Bronx River in New York City, has had to be designed along somewhat unorthodox lines. It is mounted on flanged wheels which ride on rails laid diagonally to the line of the bridge. When the bridge is to be opened for river traffic, the bridge attendant pulls the bridge along the diagonal rails by means of a windlass. Hence the bridge moves to a position parallel to, but a short distance inshore from its usual location by this diagonal movement.

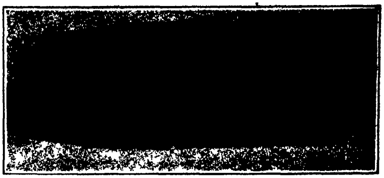
Copyright, Keystone View Co.

This bridge moves out of the way for passing river traffic by sliding diagonally on the rails shown

Putting Out Oil Tank Fires With Water

THE application of water in the extinguishing of oil tank fires was successfully demonstrated in San Francisco recently before representatives of various oil companies. The demonstrations were given near one of the municipal fire engine houses, where a tank 20 feet in diameter and 4 feet high, and a tank 12 feet in diameter and 4 feet high, were installed, both tanks being connected with a centrifugal pump having a capacity of 500 gallons of water per minute at a discharge head of 100 pounds per square inch. The pump was directly connected to a 50-horsepower electric motor

The 20-foot tank has 1½-inch lines each 7 feet 6 inches long, radiating from the center of the tank to separate individual water distributors spaced equidistant circumferentially During one of the demonstrations 12 inches of oil or 850 gallons was used in the 12-foot tank and allowed to burn until the fire was going strong, the fire being extinguished in five seconds with 25 gallons of water The fire was actually out in less than five seconds, in fact, almost immediately on the application of the water curtain which is produced by the water distributors, the latter spreading an unbroken curtain of water over and above the surface of the burning oil.

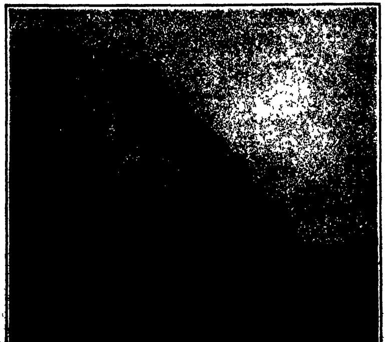


Experimental fuel oil tank equipped with a new system of water distributors for distinguishing oil fires

A four-inch water meter is installed in the suction line leading from a 3000-gallon water storage tank to the pump and a pressure gage, as well as a quick opening valve installed in the discharge line near the pump. For the purpose of regulating the water curtain, as well as being necessary to block off the line not in use, a screw stem gate valve was installed in each line to each individual tank, and a pressure gage connection was placed in each line near the tanks.

This installation gives sufficient flexibility to regulate to a nicety the water curtain desired, in addition to being able to take readings on water consumed, pressures developed friction head loss in line etc

The water distributor is the invention of a San Francisco fireman by the name of Murray



Giant floating crane lifting a 140-ton bridge, intact, to the crane pontoon, during a job of reconstruction

A Crane Which Removed a 150-Ton Bridge Intact

OUR illustration shows how a large floating crane, because of its great lifting power, may effect under certain conditions a considerable economy in time and labor In this case a new 200-ton floating crane was brought into service in connection with the reconstruction of the landing stage at New Brighton near Liverpool. As part of the work, it was necessary to remove the two steel passenger foot-bridges, leading from the end of the ferry pier to the floating landing stage. One of these is 122 tons in weight and 160 feet in over all length. The other weighs 140 tons and measures 177 feet over all. The work was done in December, and because of the heavy tide which runs at times at 7 knots in the Mersey, and also on account of the unsettled weather in December, it was necessary to complete the job of removal in one day

After the floating crane had been brought alongside the landing stage, the bridge was lifted by four slings attached to the lower chords of each of the main girders at about the third points, the slings consisting of specially flexible wire rope, six inches in circumference Each double sling passed around a hardwood block on the under side of the bottom chord.

When lifted, the overhanging portions beyond the slings were, of course, subjected to complete reversals of stress, tension members becoming compression members. The diagonal tension bars in the overhanging portions were relieved of compressive stress by means of slings passing from the upper panel point to the opposite lower panel points in the opposite direction to the tension bars in those panels.

In the work of removal, the 200-ton crane was towed up to position alongside the landing stage, the jib was slewed around over the bridge to be lifted, and the lifting hooks made fast to the slings above mentioned In five minutes the bridge had cleared its bearings on the pier The jib with its load was then slewed round and the bridge deposited on the deck of the crane pontoon. The crane was towed some two miles and moored to the river wall just south of the Seacombe Ferry, where the bridge was lowered on to timber grillages prepared to receive it The work of removing the two bridges, transferring them two miles to their temporary resting place, bringing them back, and putting them in position again, was done without any mishap.

Auxiliary Condensers and Loading Coil

A FOURTH circular in the series of descriptions of very simple radio receiving outfits prepared by the Bureau of Standards has just been issued. This is Circular No 137 entitled, "Auxiliary Condensers and Loading Coil Used with Simple Homemade Radio Receiving Outfits," and can be obtained from the Government Printing Office at 5 cents a copy

Circulars 120 and 121 described a single-circuit receiving set and a two-circuit set, respectively. The operation of either set can be improved by the use of a very simple and cheap condenser connected across the telephone receivers and a similar one connected in series with the antenna Longer waves can be received by the use of a very simple type of loading coil which is particularly useful in connection with the single-circuit receiving set.

The auxiliary condenser, which is used in series with the antenna and the loading coil, may also be used when the crystal detector is replaced by an electron tube detector unit (as described in Circular No. 133), or when an amplifier (to be described in a later circular) is added to the receiving set

The condenser used in series with the antenna makes it convenient to tune to wave lengths less than 300 meters. The condenser used across the telephone receivers increases the intensity of signals which are received from some radio stations. The loading coil enables the equipment to respond to wave lengths above 600 meters, up to about 3000 meters. Time signals from high power stations can thus be received.

Concrete in the Making

Ingenious Production Methods Evolved in the Portland Cement Industry

By George S. Eaton

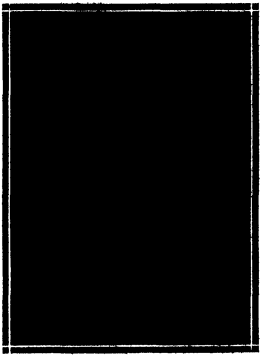
MOUNTAINS of rock, in effect must be powdered yearly in the portland cement plants of the country before the carefully proportioned raw mix can be put through the flaming kilns where it is burned into clinker. This glass-hard material in turn is pulverized to produce portland cement. And since the substances that must be reduced in such quantities to the fineness of flour are solid rock and harder clinker, special equipment with many novel features has been developed to do the work economically and rapidly. Huge plants housing much ingenious machinery now supply this basic building material for use in all sorts of concrete structures and pavements.

Without two great inventions the portland cement industry could not have attained its present development. One of these was the rotary kiln which has entirely replaced the old dome types of kilns in this country. Although greedy for coal, the rotary kiln is low in labor cost and what is of greater importance makes production on a mammoth scale feasible. Instead of a scant hundred barrels a day from the improved continuous dome kiln, the modern rotary can turn out a thousand barrels or some five carloads.

Coincident with this development in kilns and of equal importance came the evolution of the iron grinding mill. Anyone who is familiar with an old time plant with its forty or fifty mill pickers busy with their hammers sharpening the burrstones once used in grinding materials will admit that present day outputs would not be practicable without the highly developed iron or steel grinding apparatus of today. And the development in either of these two mechanical fields alone would have been insufficient—their correlation was essential.

The huge rotary kilns found today in the cement plants of the country make most unusual furnaces. If one of the largest could be set on end it would be as tall as a 20-story building. It is more than big enough for a touring car to pass through. It is heavier than four standard pullman cars. Several of these steel monsters slowly revolving side by side in a great kiln room with 30-foot tongues of flame roaring within them and white-hot balls of clinker dropping from their mouths create an impression of power and relentless purpose that is unforgetable.

The raw mix, consisting of properly proportioned and finely powdered ingredients, enters the upper end of the kiln. As this slowly turns a revolution every minute and a half or two minutes, the powder is carried up the sides before it tumbles down and forward due to the kiln's slight inclination to the horizontal. Any moisture in the raw mix is soon driven off and as the material grows hotter and hotter the lime carbonate begins to give up its carbon dioxide. By the time the temperature reaches 1050 degrees Fahrenheit a third of the original weight of the mixture has gone up the



A centrifugal type of mill for pulverizing material in the cement plant

stack as carbon dioxide alone. If a pure limestone were being used without the clayey elements added, the loss from this source would be 44 per cent.

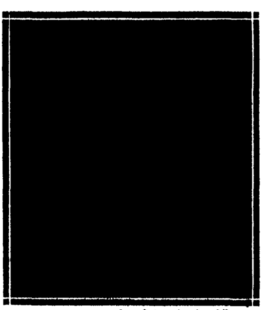
Now the material begins to get really hot, with good cause. Near the lower end of the kiln the flames attain a temperature of from 2500 to 3000 degrees Fahrenheit—a heat great enough to melt the steel shell of the kiln if it were not for the protection of the fire-brick lining. At this temperature, the materials are at the point of incipient fusion and in their finely powdered state, react chemically to form the clinker that is later ground into portland cement.

The fuel employed to produce this extreme temperature is usually powdered coal, itself the result of pulverizing operations like those to which the raw materials are subjected. Coal so finely ground burns almost like a gas flame. Millions of tons of pulverized coal are consumed every year in the kilns of the cement mills. Great quantities of fuel oil and natural gas are also used.

Control of the burning is a most important feature in cement manufacture. The visitor at a cement plant will notice standing near the flame end of the kiln a workman who from time to time holds up a pair of goggles and peers into the great cylinder. Protected by these colored glasses, he is looking into a veritable inferno of heat, noting the appearance of the clinker as it tumbles over and over on its slow advance toward the outlet. From this inspection, with the aid of the more precise information furnished by recording pyrometers and draft gages set near the exit from the kiln to the stack, the burner is able properly to control the clinkering action by varying the amount of coal blown in and the rate of rotation of the kiln.

Occasionally rings of clinker form some distance back from the lower end, materially cutting down the effective diameter of the kiln and actually damming the flow through it to a considerable extent. These rings may become three feet thick and extend into the kiln 10 to 12 inches from the lining. To remove these with hand tools necessitates stopping the kiln and letting it cool down, with the certainty of a loss in production and the possibility that too rapid cooling will cause the shrinking fire-brick lining to crack. To eliminate this large operating loss, some ingenious fellow devised the plan of shooting a notch out of the ring, causing it to collapse.

Shotguns handling a charge of one ounce of lead are employed because of the bulk of the ring. Rapid fire is essential, so that eight or ten guns are provided in order that they will not become too hot. One man fires while others load. The blast of coal dust is shut off to afford a clear sight, but the kiln is allowed to revolve in order to prevent the clinkers sticking to the lining. From 500 to 1000 shots must often be sent into the moving target, which means that the marksman's shoulder receives a terrific pounding from the recoil of the heavily loaded guns. Unusual as it is, this plan has been used with much success at some plants.



Shooting a notch through a clinker ring in a kiln may save a two-day shut-down

Clinker is an interesting material in itself. It is formed by the physical and chemical union of the particles of raw materials brought into close contact at the very high kiln temperature, which, however, is still below the true fusion point. It consists of dark colored pieces, roughly spherical, ranging in diameter from one-quarter of an inch or less to as much as two inches. Even though the raw mixture includes such materials as clay or marl, the resulting clinker is glass-hard and difficult to pulverize. It is a totally new material.

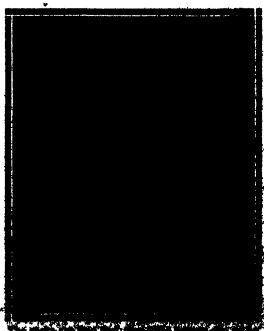
Then there is the matter of color. Although clinker is almost black, the cement made by grinding it finely is gray in color. The only addition to the clinker is about 3 per cent of gypsum, which has little effect in coloring the cement. The latter's much lighter color is due to the difference in the absorption and reflection of light by the clinker before and after pulverizing. Powdered materials often exhibit some such change in color.

While clinker needs only to be ground to become cement, which is a substance that will soon solidify into a permanently rigid mass upon the addition of water, clinker itself is inert and can be exposed to the elements for months without deterioration. Frequently it is sprinkled with water while cooling. Fine pulverizing is necessary before any cementing action can take place.

Present grinding machinery commonly utilizes the principle of pounding the material between some form of hammer and another metal mass. But the hammer may be a steel ball.

For example, a charge of several tons of steel or chilled iron balls hammers the rock fragment into bits in the ball mill often used in the first stage of grinding rock or clinker. This mill is a horizontal steel cylinder six to eight feet in diameter and four to six feet long. It makes a revolution every two and a half seconds about its horizontal axis. The balls used are of two sizes, the larger are five inches in diameter and weigh about 19 pounds each. In use, these balls rapidly wear away, so that from time to time the worn ones must be replaced by new balls.

As the cylindrical mill rotates, the balls are carried up the ascending side only to be thrown out and down to the bottom again. The principal grinding action is said to lie in the sharp blows delivered by the falling balls as they strike the particles caught between them



[illegible]

and the others at the bottom of the drum. The crushed material, passing a two-inch ring, is fed in at one end of the cylinder. When fine enough, it passes out through an enveloping screen that is fastened to the steel lining plates and rotates with the mill. The particles leaving the ball mill commonly are about the size of medium-sized sand grains.

Other machines often used for grinding are known as hammer mills. In these, swinging hammers deliver the blows that break up the materials. Still other even more common types are called centrifugal mills, since their operation is dependent upon centrifugal force.

In one particular kind of centrifugal mill a single steel roll is suspended on a vertical shaft attached to a pulley by a universal joint. The roll is rapidly rotated, and swings out as it revolves until it bears against the inner face of a steel ring or circular die with great force. The pieces of rock caught between the two are ground up. When fine enough, these particles are sucked up and forced through enclosing screens by fans set over the roll. Such a mill is an efficient pulverizer.

Steel cylinders 20 feet or more in length are very often employed in reducing the product coming from the ball mill to the very fine powder that is fed into the kilns. These are filled about half full with flint pebbles, or more commonly since the war, with steel balls and slugs. The latter are small cylinders about an inch long by a half inch through. Such mills are known as tube mills.

Almost any operation in the long manufacturing process contributes something unusual. For example, consider the sacks of cement seen on practically any construction job. Very prosaic in appearance, certainly—yet those sacks were securely tied with steel wire before they were filled with cement. This operation of filling a fastened container is performed many millions of times a month, for in 1922 enough portland cement to fill over 455,000,000 of them was produced in this country.

Less than 20 years ago the filling of cloth or paper sacks with cement was still a slow, back-breaking operation. Cement was stored in bins and workmen filled the sacks with shovels. As every sack had to contain 94 pounds, it was necessary to stop and weigh each package before it was tied, adding materials as needed to bring it to the standard weight.

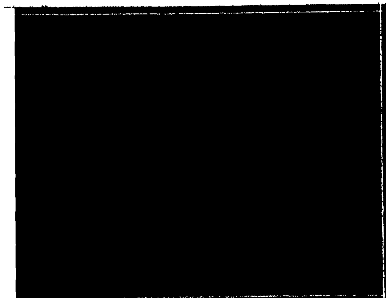
Today the filling is done by machines, and these machines have brought with them this type of sack that is tied before it is filled. The sack is provided with a self-closing valve in the bottom through which cement flows in, aided by an elaborate mechanism.

When the requisite 94 pounds of cement have been put into the bag, the flow is cut off by means of a scale, automatic in operation. The full sack then drops to a moving belt that carries it out to the freight car. By this method a crew of four men can fill and load 8000 sacks a day against an output of 1600 under the old hand-labor methods.

The valve itself is made when the cloth sack is sewed up, by folding over one bottom corner before a seam is run along the bottom and up one side of a doubled strip of cloth. When the sack is now turned right side out this flap valve forms an inlet through which cement can flow. The sack is hung on the filling machine upside down with an inch tube inserted through the valve. Once filled and righted, the sack is proof against leakage, since the weight of the cement holds the flap valve closed.

Cement clinker is an inert substance, but when ground into cement it soon hardens on addition of water. The grinding brings it down from the size shown, to an almost impalpable powder that will pass through silk cloth

Both the preliminary and the final grindings of the clinker and the cement itself are carried out in ball mills of one sort or another, of which this drawing shows a typical example, broken away to reveal the mechanism



[illegible] used in breaking up lumps in the clay used in a wet-process portland cement plant. Without them, it would not be possible to get the necessary [illegible] in the "slurry" or mixture

In the raw materials from which portland cement is made the major constituents—lime, silica and alumina—must be present in the right proportions. Also they must be unaccompanied by injurious amounts of other ingredients. Proximity to centers of population is desirable, as freight charges mount up rapidly upon such a heavy, low-priced commodity as cement. This means that usable deposits suitably located for economical manufacture are comparatively rare. Yet the raw materials themselves are a small part of the cost of cement manufacture, as it is the great amount of machinery, the fuel for burning the clinker and the power needed to operate the mills that are the important factors. Last year portland cement was made at 117 plants in 27 States located in all sections of the country.

The combinations of materials commonly burned together in manufacturing cement are limestone with clay or shale, limestone with blast furnace slag, cement rock with limestone, and marl with clay. In each case, the principal constituent is named first.

Cement rock is a stone, found principally in Pennsylvania, that combines the necessary elements in approximately the correct proportions. Marl, in the sense meant here, is a granular, loose deposit of limestone found in the basin of an existing or extinct lake. The blast furnace slag referred to is especially prepared for cement manufacture by granulation while molten.

Two general processes of manufacture have been developed, the dry and the wet. These vary in methods but not in principle.

In the dry process, rock is crushed to a two-inch size by passing the pieces from the quarry through some sort of a primary crusher, followed by a battery of smaller ones. Materials are next dried, and then go to the grinding mills for pulverizing before they are burned.

Slurry is the term applied to the raw mix in the wet process, used where marl is an ingredient and in some instances with limestone instead. Enough water is added to the materials so that they can be ground into the soupy mixture called slurry. This is often reduced to an even finer state than is the case in the dry process. In order to secure a uniform mixture, barrows much similar to those used on the farm, but with enormous teeth, may be dragged around in the tanks into which the clay is dumped from storage before it is added to the other material. Giant paddles revolving in the slurry tanks prevent settlement of the particles and compressed air blown in at the bottom bubbles up through the mixture, keeping it continually agitated. The slurry is pumped like water into feed tanks, from which it passes to the kilns.

Careful methods of control in manufacturing cement have of course been worked out by the cement plant chemical and physical laboratories, as the product is sold to conform to the specifications adopted by the American Society for Testing Materials, and the United States Government.

Among the many unusual pieces of apparatus relied upon in testing cement, none is of greater interest than the 200-mesh sieve. One of the requirements is that

(Continued on page 142)

Where the Temperature Is 434 Degrees Below Zero

The Work of the Bureau of Standards in Liquefying and Freezing Hydrogen, Lightest of Gases

By S. R. Winters

THE LOWEST temperature ever recorded in Washington, D C, and possibly the coldest degree yet attained in the United States, was achieved recently when Dr. C W Kanolt of the Low Temperatures Laboratory of the Bureau of Standards, United States Department of Commerce, produced solid hydrogen. The thermometer would have registered 434 degrees Fahrenheit below the commonly accepted zero point, and only 25 degrees above absolute zero, which is 459 degrees Fahrenheit Liquid hydrogen was manufactured at a temperature of 421 degrees Fahrenheit, the fluid then being easily transformed into flakes resembling snow or ice.

Hydrogen—a gaseous element that is colorless, tasteless, odorless, and the lightest known substance—has heretofore been converted into a liquid and a solid About a quarter of a century ago Sir James Dewar, a noted English physicist who died on March 27, 1923, first produced liquid hydrogen, and two years later he realized the production of solid hydrogen Dr C W Kanolt and his co-laborers at the Low Temperatures Laboratory of the Bureau of Standards, however, are probably the first scientists to achieve the distinction of devising a method whereby both liquid and solid hydrogen may be dependably manufactured in quantity production

Uncle Sam is tackling the production of liquid hydrogen with a two-fold object in view First, gaseous hydrogen lends itself to the attainment of extremely low temperatures, and by extensive experiments the Bureau of Standards contemplates that this operation will be established on a practical basis Second, these investigations have for their purpose the solution of difficulties arising from the methods of manufacture, thereby facilitating the installation and operation of hydrogen liquefiers in Government and university laboratories. A relatively small quantity of liquid hydrogen was first manufactured at the Bureau of Standards several years ago by T B Ford, then a member of the staff of the Low Temperatures Laboratory He employed old and extremely troublesome machinery Recent experiments, however, have been negotiated through the use of newly installed apparatus, and two liters of liquid hydrogen can be produced hourly without experiencing much difficulty from the clogging of the machinery

The method of converting gaseous hydrogen into a liquid state is somewhat analogous to the process of manufacturing liquid air. Briefly told, this method consists of, first, in compressing the air to a high state of compression, approximately 200 atmospheres, or the application of 3000 pounds of pressure to the square inch. The resultant heat is displaced and the air is partly purified It is then preferably, but not necessarily, pre-cooled to a point of a few degrees below ordinary or room temperature The air is subsequently given passage through a heat interchanger and permitted to expand to atmospheric pressure through a valve The expanded air is allowed to pass back over the heat interchanger as a means of cooling the incoming compressed air Thus a negligible quantity of cold is squandered. The apparatus cools until a portion of the air is transformed into a fluid.

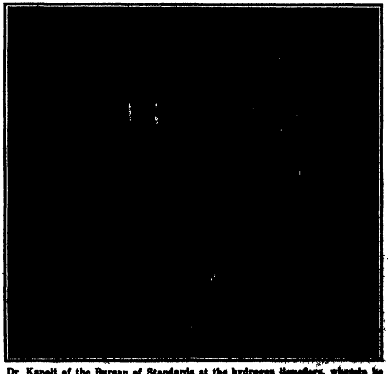
Hydrogen is liquefied in a similar manner, save in one essential particular Instead of beginning the process of manufacture while the gaseous hydrogen is at room temperature, the compressed gas is first cooled to approximately minus 200 degrees Centigrade, which descending point on the thermometer scale is attained by the forced evaporation of liquid air under reduced pressure. Several difficulties are encountered during the course of this process of manufacture, notably among these obstacles being the impurity of the hydrogen The slightest trace of air in the latter will freeze out solid air in the expansion valve and speedily clog the mechanism. This untoward circumstance may occur even when the hydrogen seems to possess 100 per cent purity, according to the conventional methods of gas analysis. The absence of extremely sensitive apparatus for making determinations of the purity of gases is responsible for this condition

AS a standard against which to compare the freezing point of hydrogen, around which Mr Winters' story revolves, the following temperatures may be borne in mind

Mercury freezes at	38 below
Coldest weather ever observed in U S	61 below
Coldest weather observed in world	90 below
Alcohol freezes at	142 below
Oxygen liquefies at	297 below
Nitrogen liquefies at	319 below
Nitrogen freezes at	347 below
Oxygen freezes at	360 below
Hydrogen liquefies at	421 below
Hydrogen freezes at	434 below
Absolute zero, at which matter may cease to exist	459 below

These temperatures, like those in Mr Winters' text, are in the familiar Fahrenheit scale, rather than the Centigrade that is ordinarily used in scientific work —THE EDITOR.

Nitrogen is the objectionable impurity in hydrogen Thanks, however, to a process developed at the Fixation Nitrogen Laboratory of the United States Department of Agriculture, it is possible to analyze gaseous hydrogen at the different stages of its production and use and locate the sources of contamination. For its own needs the Bureau of Standards is manufacturing hydrogen by the electrolytical method. This gaseous substance is collected in a holder, containing oil instead of water, and is compressed into cylinders for storage. As the hydrogen comes from the generator it contains approximately one-hundredth of 1 per cent nitrogen, which, subsequent to compression in cylinders, possesses two-one-hundredths per cent of nitrogen. The oxygen gaining admission into the generator is eliminated as a separate element by an apparatus that dispenses sufficient heat to the gas to effect a combination of the oxygen and hydrogen. Any water present can be removed by common drying agents; and, in fact, the presence of a trace of water does not involve a serious difficulty The use of a device for warming the expansion valve in the removal of a plug of frozen air, in the event of clogging, was temporarily attempted, but in recent operations this auxiliary unit has been discarded for the time being.

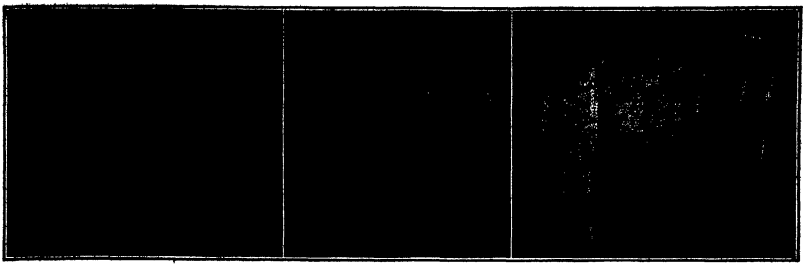


Dr Kanolt of the Bureau of Standards at the hydrogen liquefiers, wherein he is producing liquid hydrogen regularly, in quantities

Liquid hydrogen is the lightest fluid known. The figure of speech, "light as a cork," is thrown into discard, when compared with the weight of hydrogen in a liquid state. A cork, for instance, sinks in liquid hydrogen because it is three or four times as dense as this fluid. A container of liquid hydrogen is so light that one cannot easily detect the presence of it in a vessel by any additional weight imposed. Its viscosity is exceedingly low—about one-ninetieth of that of water Hydrogen in a fluid state, like liquid air, may be preserved for 24 to 48 hours by means of vacuum-walled containers. The latter are barriers to the entrance of heat from immediate surroundings. Pressure alone, however, will not preserve either hydrogen or air in a fluid state.

Once gaseous hydrogen has resolved itself into a liquid, the transformation to a solid is only a single step and one relatively easy of accomplishment. The fluid is reduced to a lower temperature—approximately eleven degrees on the thermometer scale—by rapid evaporation of the liquid in a partial vacuum Solid hydrogen bears similarity to flakes of snow and ice and they are extremely light It is difficult, if not well-nigh impossible, to preserve hydrogen in a solid form for any duration of time. For example, Doctor Kanolt was unable to carry a specimen from the laboratory for a distance of four or five miles before the flaky substance melted. However, according to the method being employed, it can be manufactured fairly rapidly and dependably in quantities desired Solid hydrogen is the lightest solid known, it being one-third lighter than cork

Sir James Dewar, inventor of the well-known vessel that bears his name, and the first person in the world to produce liquid hydrogen in a sufficient quantity to be positive of his achievement, recently died at his home in England. Fortunate, is it not that the efforts of his research should be continued without interruption and attain full fruition at the Bureau of Standards of the United States Department of Commerce? The Dewar vessel is essential to the process of manufacturing both liquid and solid hydrogen. The first liquid hydrogen placed on exhibit in the United States was that displayed by Professor Dewar at the St. Louis Exposition in 1903. Subsequently, Government agencies and educational institutions have spasmodically manufactured the rare fluid, notably in the laboratories of Kamerlingh Onnes, at Leyden, Netherlands, the University of California, in America; and laboratories in European countries. However, it remained for the Low Temperatures Laboratory of the Bureau of Standards, United States Department of Commerce, to apply a standard of precision and dependability of production in the manufacture of liquid and solid hydrogen. This is notable, not only on its own grounds, but equally in view of the fact that it means the development, regularly and as a matter of routine, of temperatures within twenty-five degrees of the absolute zero temperature which, a generation ago, no scientist would have attempted to attain save as an extraordinary laboratory "stunt."



Left: How six porcelain insulators are combined to make a wieldy package where one would be quite impossible. *Center:* The problem of shipping automobile tires without losing the tires or losing space is met by packing them in a hexagonal box. *Right:* This extremely clever crate carries six pails of candy for export in perfect security

Trick boxes that are necessary for long-distance shipping of merchandise of trick shapes

When the Packer Turns Inventor

AMONG the ancient proverbs there is one that tells us something about the advisability of cutting one's garment to fit one's cloth. Presumably the original author of this bit of sage advice did not know anything about packing merchandise for shipment. If he had, and if he had had before him the examples of how to perform this difficult task which we see at the top of this page, he might have modeled his proverb a little differently, making it have reference to the extreme advisability of building the box to fit the contents.

All of us, presumably, can make a fairly presentable job of wrapping a bundle—just so long as the bundle preserves the shape known to the mathematician as a parallelepiped. When the square corners make way to round ones or even to projections, and when the flat sides give place to eccentricity of outline, the difficulty of draping the article in paper and string is vastly increased. And when, instead of paper and string, it must be draped in a wooden box that will stand up against all the rigors of ocean freight shipment, the shipping clerk has a problem on his hands that calls for no little expenditure of gray matter.

One line of attack consists in the use of boxes or crates with internal partitions or compartments. High voltage porcelain insulators are an example of the sort of merchandise requiring such treatment as this from the packer. They are of awkward shape to begin with, and breakable in the bargain. Instead of trying to make a box that will hold one of them, they are piled up, six high, in a long and narrow crate, as illustrated. With all the protecting parts of this crate, internal and external, in place and properly secured, the insulators are all fixed for a trip to any part of the world.

When we come to pack objects of curious shapes, the most natural thing to do, once we have visualized the problem that they present, would doubtless be to employ a specially shaped box that shall more or less conform to their outline. But if we do this without further thought we shall get ourselves in trouble. Ocean freight rates depend upon space occupied as well as upon weight; and if we turn over to the steamship a lot of oddly shaped containers that cannot be economically stowed away, we shall have our carelessness reflected on our freight bills in short order. Nevertheless, it is possible to ship trick articles in trick boxes, if we but make them of such shape that their projecting edges and corners will fit together well. The honey bee knows as well as the geometer that hexagons can be thus packed together; and the shipper of automobile tires knows it too, as our second picture shows.

The crate shown in our [illegible] is in some respects the cleverest of them all. A pail of candy for shipment to a foreign land is indeed a problem for the packer. When he assembles six of them in the fashion shown, however, with proper packing to hold them in their crate without slipping, the difficulties of making a square package out of a tapering circular one disappear immediately. Simple as all these boxes are when we have once seen them, their simplicity is really much like that of the egg trick that helped to make Columbus famous, and their development required no little exercise of the inventive faculty.

Marking Laundry by Machine

THE mechanical marking room of one of San Francisco's large laundries, especially designed and installed, is the most mechanical marking room in the world. This is because it has specially designed conveyors which convey the bundles to the operator, and also conveyors which convey the goods from the operator to the classification room.

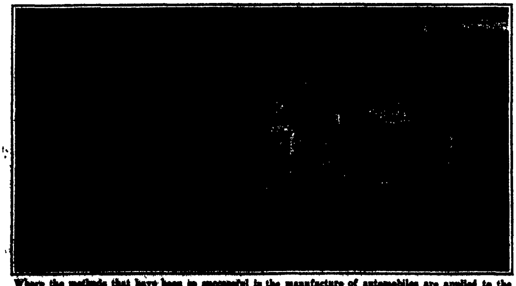
The bundles are opened by the operator shown in our photograph at *A*. He stands at the desk at the end of one of the conveyors, which delivers the bundles to him. His duty is to break the bundle, write the mark on the list, and keep a record of all marks given out, so as to prevent duplicate marks. The laundry list is then put back in the bundle, and the bundle placed on the conveyor as shown at *C*, the bundles being conveyed toward the markers in the booths, giving the markers an even distribution of work.

The conveyor *B*, is provided with a special device shown at *R* and called a limit switch, which provides an automatic method of stopping and starting the conveyor. When the bundle of clothes on the conveyor travels to a point where it comes in contact with the limit switch, *R*, the electric motor that drives the conveyor is automatically stopped, and as soon as the marker removes the bundle that is in contact with this switch, the motor automatically starts up and drives the conveyor until another bundle comes in contact with the limit switch when the conveyor will again be stopped.

The following shows the steps through which the clothes are carried in this mechanical marking room. The marker in the booth removes a bundle of clothes from the traveling conveyor and puts it in her work box, finds the laundry list which has the mark thereon, and sets the mark on her machine. This machine has a keyboard like an adding machine or typewriter. The marker picks up the first article on the top of the bundle with the right hand and "counts" it with the left hand. If it is a shirt the marker presses on the shirt key on the counting device, shown at *E*, marks the shirt and throws same to the take-off conveyor on her right, which is shown at *OO*, this conveyor delivering the goods to the classification room, from which point the goods are delivered to the washing machines.

When the marker finishes counting and marking the bundle in the manner just described, she lays the laundry list on the table of the counting device and lifts the table of the counting device to contact with the type and the count is transferred from the machine to the laundry list. This counting device adds up the number of each article, something like the ordinary adding machine, relieving the marker of this work.

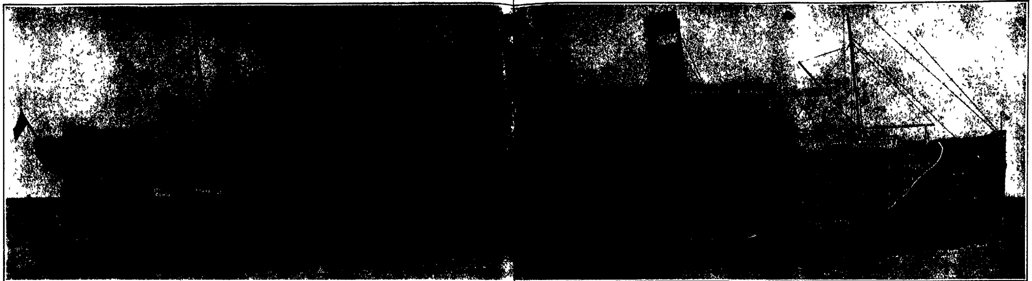
All articles in the bundle are handled in this manner, with the exception of the knit goods, table linen and dark colored goods, on which an ink mark will not hold, or which it is not desirable to mark with an ink mark. Goods of this class are laid on the top shelf—running the full length of the booths, at the left and shown at *H*. An operator takes these goods from this shelf and takes them to the machine shown at *K*. She sews a patch on each piece of goods with this machine, then puts the proper laundry mark on the sewed-on patch with the power marking machine shown at *V*. By combining these various conveyors with the marking and counting devices, a great improvement has been made over the method previously employed, under which all marking of the laundry and all counting of the various pieces and marking same on the laundry list was done by hand, with the aid of a single conveyor. The laundry industry ranks high in the application of labor-saving devices.



Where the methods that have been so successful in the manufacture of automobiles are applied to the marking of laundry. The reference letters are explained in the text

Finland Hydroelectric Plant

FINLAND'S largest hydroelectric power station, harnessing the energy of the Vuoksen Rapids, is well under way. The total head is to be utilized in four steps, the second being now under construction. When the plan is fully realized there will be a yield of 392,000 turbine horsepower, with a possibility of increasing this to 680,000 horsepower through controlling the water level of the Saima lakes.



The "Leviathan" is 950 feet long, 100 feet broad, 100 feet from keel to top deck, and displaces [illegible]6,800 tons. Her maximum horsepower is over 100,000. She carries 4513 passengers and crew

The Reconstructed Leviathan

Story of the American Effort to Render this Ship the Safest and Fastest of the Three Great Ex-German Liners

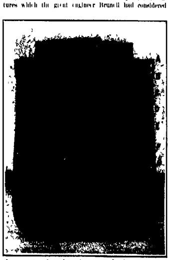
IF WE were asked to name in their order of importance the qualities which should characterize an ocean liner we should put safety first, then comfort and then speed. With this statement the average ocean voyager will undoubtedly agree, for in setting sail for a distant port he will want to be perfectly sure of getting there with a reasonable degree of comfort and at the highest possible speed consistent with the two major considerations.

The safest ocean liner ever constructed was the "Great Eastern," built three-quarters of a century ago. As a protection against flooding she was provided with two complete hulls, the inner one three feet from the outer one, and the space between was many celled as a honeycomb. In case both hulls should be pierced, she was sub-divided transversally by fifteen water-tight bulkheads, nine of which were carried to the top deck thirty feet above the waterline. During the fifty years subsequent to the "Great Eastern," the call for speed, luxury and dividends led to the gradual elimination of most of those protective features which the great engineer Brunell had considered necessary to render the "Great Eastern" safe against foundering at sea. Today in the average ocean liner, all that is left of the double shell is the watertight bottom, and the transverse bulkheads instead of being carried to the top deck, are liable to extend, as they did in the "Titanic," to only ten feet or less above the waterline.

After the loss of the "Titanic" a meeting of naval architects and shipping men of all maritime nations was called in London to determine what improvements should be made to render ships safe against sinking at sea. The rules adopted by the International Committee resulted in a certain increase in the safety elements of ship construction, but the writer has always felt that humanitarian considerations were given too little thought and considerations of dividends too much. As evidence of this, consider the fact that under the present rules for bulkheading, as adopted at that great international gathering, a ship is considered to be safe if, with two of her largest compartments flooded, she settles in the water until the top of her bulkheads is only 2½ inches above water.

A Three-Compartment Ship

We have given this rather lengthy introduction in order to emphasize the fact that the "Leviathan" was so constructed that she greatly exceeds the above safety requirements and is therefore a thoroughly safe ship. If she should meet with an accident so terrific as to flood three of her largest compartments, her lowest bulkhead deck would still be floating at a higher level than that required by the bulkhead committee in a ship with only two of her compartments filled. It was to this question of safety that the naval architect, Mr. William F. Gibbs, who had charge of the reconditioning of the "Leviathan," gave his first attention. As he expressed it to the writer, "When I undertook the task of reconditioning the ship, I realized that the first obligation laid upon me was to render the "Leviathan" safe against being sunk by any reasonable accidents of the sea, and my first effort was to incorporate all the additional safeguards against foundering which it was possible to provide in a ship which was already built."



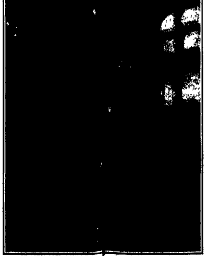
Cross section through engine room, showing eleven separate decks. Dining-room on F deck extends full width of the ship and is 120 feet in length

Lofty Bulkheads

When a ship is damaged by collision the breach in her hull is usually forward of amidship, and she begins to settle by the head. If the bulkheads are low, the water rising within a forward compartment to the top of the adjoining bulkheads flows over into the next compartment, and so, by successive flooding, her buoyancy is ultimately lost and she sinks. Evidently the height of the bulkheads should increase from the center of the ship toward the ends. The lowest bulkhead deck (the bulkhead deck is the one to which the bulkheads extend) in the "Leviathan" is amidships, and is at an elevation of 18 feet above the load waterline. The other bulkheads, forward and aft, increase in height toward the ends, where five of them extend right through to the upper deck with a maximum height above the water line of 24 feet aft and 33 feet forward. Furthermore, to prevent buckling of the bulkheads or their tearing loose, extra stiffening has been provided and additional rivetting to the tank top. In a rough sea, the surging of the water within a flooded compartment produces heavy stresses on the bulkheads.

Permanently Closed Portholes

Open portholes constitute a serious danger to a ship, the extent of which is too little understood. A ship that is breached by collision heels quickly until she puts her lowest line of portholes under water. The amount of water that can enter a ship through a few open portholes, especially when it enters under the pressure of several feet of head, is enormous. To get rid of this great risk, Mr. Gibbs determined to abolish all hinged portlights below "F" deck. Hence, the portholes on two decks have been permanently closed by one-inch, triplex, glass lights and provided with interior steel portplates for use in case any glass should be broken. Consequently there can never be a porthole open below "F" deck, or for a height of about 20 feet above the load waterline. The many scuppers have been concentrated in a few large hydraulically operated scuppers, all of which can be closed from the bridge.



A corner of the great social hall, which measures 26 feet from floor to ceiling

Bulkhead Openings Plated-Up

When the "Leviathan" was handed over for reconstruction, her system of ventilation for the boiler rooms was built on a plan which largely destroyed the effectiveness of the bulkheads as a provision against sinking. Fresh air was drawn in through deck openings abaft the bridge, and carried down to a large horizontal rectangular duct which was built on the underside of the bulkhead deck and passed successively through all the boiler room compartments. The air was admitted from this duct to each compartment through a hydraulically-operated door, which was to be closed in case of collision. These doors measure 5½ by 9 feet, and because of their liability to jam in an emergency, it was considered that the system was a menace to the safety of the ship. Therefore, the whole of this ventilating system was removed, and independent vertical ventilation shafts, leading directly from the top deck to each boiler room were substituted. How greatly the margin of safety in the "Leviathan" has been increased by these and other changes, is shown by the fact that, whereas formerly she possessed 33 hydraulically-operated water-tight doors below the waterline, 18 of these have been removed during the reconstruction and there are now only 15 such doors in the whole ship. As an additional safety measure, the deck above the engine rooms has been made water tight.

Ballast Tanks and Pumping Plant

An important element in the protective features of a ship is the provision of ballast tanks and a powerful pumping plant capable of making a rapid transfer of water ballast to regulate the trim of the vessel. Great attention is paid to this feature in the design of warships, and the ability of some of the German battleships to remain afloat and get back to port after being severally punished in the Battle of Jutland was due to the excellent methods employed on their ships. This feature has received special attention in the re-conditioning of the "Leviathan." The capacity of the bilge pumps has been increased, and they can deliver overboard a total of 1780 tons of water per hour. Mr. Gibbs does not believe in the use of longitudinal bulkheads, for by preventing the free flow of water across the ship they increase the keeling. Hence they are regarded by many naval architects as a source of danger rather than a protection. On the other hand, a feature in the "Leviathan" which answers the same purpose as the double hull of the "Great Eastern" is the narrow oil tanks which extend along the sides of the ship and flank the forward compartments. These have been made water tight and hydraulically tested. It is claimed that the long slicing blow which opened several forward compartments of the "Titanic" would not sink the "Leviathan," since it would merely open these oil tanks to the sea and no water would enter the main compartments.

Determining the Lines and the Weight of the Ship

The strong sentimental hold of the "Leviathan" upon the American public is due to her wonderful record when she carried over 150,000 of our soldier boys safely to France and brought them home again. When she was turned over to the Shipping Board for reconstruction, the Government was without a single plan of the ship. The Germans demanded one million dollars for these plans. Rather than pay that sum the Shipping Board determined to draw up complete plans based upon actual measurements of the vessel. This was an enormous task and necessitated the employment of a staff of 250 engineers and technical men who worked upon the job for several months. The lines of the ship were taken off from within, by offsetting from the central vertical plane of the ship. Some of these offsets has to turn as many as eight corners before they reached the shell of the vessel, yet the job was done so accurately that the form, as thus determined, was nowhere out more than one and a half inches from the hull as actually built. The cost of getting out these plans was about $250,000, or one-fourth of the sum demanded by the builders.

The ship itself, both as regards hull, boilers and engines, was a good job, characterized by the efficient work which is found in first-class German vessels, but every part of the vessel was overhauled, and not only was a large amount of new auxiliary machinery installed, but many improvements were made, including entirely new systems of plumbing, heating and lighting, and the change of the boiler plant from coal to oil burning. These many changes are believed by the Shipping Board to constitute this ship the most up-to-date of all the great liners of her class.

Dimensions of the Ship

The length over all of the "Leviathan" is 950 feet, her breadth 100 feet, her molded department to "D" deck is 70 feet 4½ inches, her loaded draft 40 feet, and her full load displacement [illegible] tons. She carries 1115 officers and crew and 3398 passengers, or a total complement for the ship 4513. Steam is raised in 46 modified oil-fired Yarrow boilers and power is developed on four direct-connected Parsons reaction turbines whose maximum power with all overload nozzles open should be well over 100,000.

(Continued on page 143)

Cross-section through boiler rooms, showing the uptakes from boiler rooms divided to accommodate the unbroken sweep of the social hall, Ritz restaurant, etc.

Women on the Farm

The Role in Our National Life of the Wives and Daughters of Agriculture

By George H. Dacy

DESPITE that the census classifies farm women under the heading "no occupation," these rural home-makers are among the busiest employed in direct agricultural activities or related lines of work. Daily their work begins just an hour or so after daylight—during the summer even earlier—while their hundred and one tasks usually engage their attention until after everyone else around the farm homes has gone to bed. No one has any record of "cum laude" or emeritus honors being bestowed upon farm women yet these patient, persistent and plucky toilers deserve the highest awards which can be granted to womanhood.

Heretofore, little attention has been accorded the conditions, environments, equipment and facilities under and with which the farm women of this country work. In fact the first detailed and authentic information along these lines obtains from a recent scientific survey which has been conducted by the national Department of Agriculture. In cooperation with the state agricultural colleges and the county demonstration agents, Uncle Sam has attempted to learn first-handed from the farm women, themselves, concerning the conditions under which they accomplish their daily duties. Complete records were received from 10,044 women who live in 35 different northern and western states. The data were gathered from carefully selected, typical farming communities in several of the leading agricultural counties of each of these states. Most of the localities covered contained from 85 to 50 farms and in the case of each section which was surveyed, a record was secured from every farm home in the neighborhood irrespective of the size of farm, character of tenancy, prosperity of the farm family or associated conditions.

This minute study of the daily doings of the average farm housewife shows that she plays many roles, from cook, seamstress, laundress and nurse to family purchasing agent, producer of dairy, garden and poultry products, teacher of her children and member of the local country clubs—if there are any. Her morning starts at five or six o'clock when she lights the kitchen range and begins preparations for breakfast. She draws the water for breakfast from a well or cistern located anywhere from 10 to 200 feet from the house—many of these sources of water supply being without pumps. On Mondays she beats the sun up and draws additional water to wash the family clothes. She is not aided by an electrically operated washing machine, wringer and like facilities as only one out of every 100 farms even has a mechanical washing machine. Usually she does the washing unassisted either by human hands or automatic appliances.

Generally when breakfast is ready, she awakens the rest of the family, dresses several children for school and prepares their lunches. When everybody's appetite has been appeased, the housewife has to wash the dishes, feed the chickens, wash the milk pails and cans, gather the vegetables from the garden during the summer or she has to carry them from the cellar during the winter for the subsequent meals. Then on all days except wash day, attention has to be devoted to the routine making of beds, filling and cleaning of lamps with mending and the ironing to occupy all the extra time which she does not devote to these essential tasks. Then there are the other two meals to get, baking, sweeping and dusting as well as the marketing to attend to—all competing simultaneously with a couple of dozen other hurry-up jobs for the time of the farmer's wife.

The national survey shows that 9000 of the farm women who were visited by Uncle Sam's representatives reported that they worked an average of 11.3 hours a day—the year around—while 87 per cent of them said that they never took any vacations during the entire year. For the most part, the complexity and tediousness of the various household tasks could be eliminated if the principles of modern business and efficiency were applied to the homely work of handling the farm home. If the general run of farm homes were as well equipped as the ordinary dairy barn with labor-saving appliances, the duties of the farm women would be materially reduced. Approximately 79 per cent of the farm homes reporting in this survey announced that they still used kerosene lamps—and these figures are probably quite accurate for the rural United States in its entirety. The installation of modern lighting systems would measurably lessen the toil of the farm wife and would make the rural home more cheerful and pleasant for the farm family.

There are some farm homes—but they are lamentably in the minority—which qualify as satisfactory and modern abodes and which eliminate the back-ache and drudgery from rural culinary and housekeeping pursuits. To a certain extent, a perceptible—although extremely minute—progress in increasing the standard of rural living is apparent in all sections of the country. Some homes in every community are divorced from the erstwhile hardships to which the housewives have long been accustomed. The telephone and automobile largely have freed the farm families from isolation; rural engineering has mastered the problems of sanitation; community centers have been productive of increased sociability among country folks while modern machinery has curtailed much of the laborious hand work formerly associated with both field and kitchen tasks. Despite all these easily available and adaptable facilities for improving general living conditions in the rural regions, Uncle Sam's survey shows that the rank and file of farm families is still sadly handicapped because they have not been able to realize benefits of this description.

As matters stand, the waste of rural womanpower each year is stupendous. Women waste valuable time in drudgery when with the assistance of some of the modern machines, they could not only perform routine, menial labors much better and at less cost but they also would have more time to devote to the more important tasks connected with the successful operation of their homes. Expert, healthy, alert, ingenious and active homemakers are the economic hubs around which the wheels of rural progress revolve. The government statistics indicate infallibly that if farm women—as a class—were permitted to exercise more brain power and less brawn in their daily activities, their innate ability—aided by efficient household appliances and modern methods of management—would enable them to do better work in less time than now is possible.

Seventy nine per cent of the farm homes in this country, at present, are yearning for modern lighting systems to replace the kerosene lamps now in use. Better lights mean a more cheerful home and operate directly for the education of the farm family as they would encourage more reading by the farm folks. Close to 54 per cent of the farm women not only have to start coal and wood fires each day during the cold period but they also have to carry the fuel and tend these fires during the day. Artificial lighting systems are not expensive; neither are heating systems and every farmer who neglects to provide these conveniences not only is increasing the drudgery and housework bondage of his wife but he also is paving the way for [illegible] farm children to migrate as soon as they are of age from the farm to the city where the conveniences are superior, where the wages are higher and where the opportunities for recreation, education and general development are more abundant.

Probably more than 80 per cent of the [illegible] farms in America are equipped with some kind of artificial power such as gasoline or steam engines or even an electric dynamo. Despite this extensive

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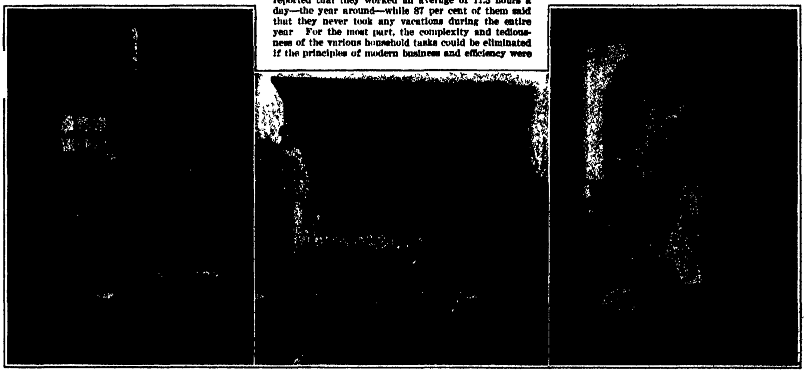
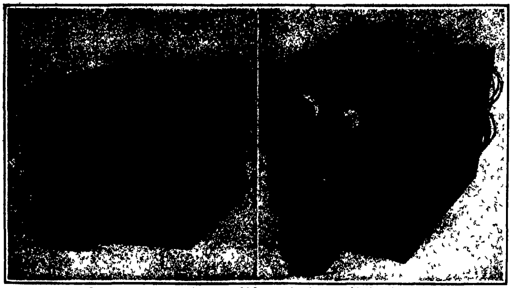


Left: Only one-tenth of one per cent of the farm women surveyed have hired help all the year around. *Center:* Eighty-one per cent of these women care for the poultry on their farms. *Right:* Showing the use of the kitchen cabinet and the fireless cooker handy kitchen apparatus for use in rural homes

Some of the results of a survey of the women on 10,044 typical farms

A Dummy Aircraft Observer

THE dummy watchman in the corn field as a fright to crows is common in the corn-producing areas, but for the first time a dummy observer is being employed on aircraft. The aeronautic instrument section of the Bureau of Standards, United States Department of Commerce, recently developed such a device for use by the Air Service of the War Department in performance tests during aircraft flights.



Two views of the dummy aircraft observer which records photographically the performance of an airplane or airship

In testing an airplane it is essential to know the actual conditions that prevail during the performance flight. Heretofore, a human observer noted the behavior of the air-going machine subject to test, but obviously there are limitations imposed upon the human eye in determining the action of the various instruments thus employed. Hence, the introduction of the dummy observer, which consists of a camera commonly used in the motion picture industry for photographing titles. Not only are the readings of a series of aircraft instruments recorded simultaneously on a film, but the inclusion of a clock among the recording apparatus makes possible the indication of the precise time at which the photographic exposure was made.

The motion-picture camera is directly driven by a small electric motor through a flexible shaft. It is placed opposite the instrument board in the fuselage of the airplane subject to performance flights. The electric motor, operated by means of a storage battery, is located within the reach of the pilot, whose command of the dummy observer is reduced to the simplicity of turning on and off a switch in the cockpit. As indicated by the photograph illustrating this article, the performance test instruments are compactly arranged in a wooden box, including an automatic timing control for the camera.

Preliminary tests of the dummy aircraft observer by the Air Service at McCook Field, Dayton, Ohio, involved the photographing continuously on a motion picture film atmospheric pressure exerted on the upper and lower surface of the wings of an airplane in flight. Measurements of these various pressures were recorded at the same time. The behavior of aircraft could thus be photographed in normal horizontal flight or in the course of turns, loops, spins, or other stunts in the air. In other words, this camera visualizes on a film at specified intervals of time quite an array of performance test instruments.

When designing an airplane it has heretofore been extremely difficult to anticipate with any degree of accuracy the atmospheric pressures that the various parts may be expected to withstand. The aeronautic instrument section of the Bureau of Standards, in adapting the motion picture to the role of dummy observer, seems to have solved the problem. The pressure distribution exerted upon the horizontal surfaces of the tail-rudder, elevators, and stabilizers is obtained by connecting the atmospheric pressure instruments by means of tubing to the surfaces in question. The various instruments are calibrated in pounds to the square foot. The opposite sides of the diaphragm in these instruments are connected to the top and bottom, respectively, of the surface to be measured. Or differently expressed a surface that indicated pressure on the bottom and suction on the top would have the resultant action integrated in the instruments. And in the course of the performance test flight, the exposed films indicate the instrument reading, or the air pressure at a particular point during any flying stunt which the pilot desires to throw the spotlight of searching inquiry.

According to the Bureau of Standards, this novel departure in registering instrument readings affords records that are more accurate than those obtainable by the conventional method.

The Latest Motion Picture Outfit for Amateurs

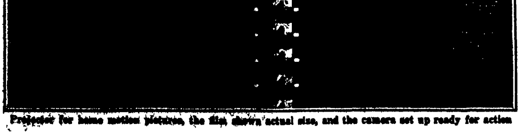
AN amateur motion picture outfit by which the amateur may take and project his own "movies" is the latest development of the leading American manufacturer of photographic apparatus. Dr. C. E. Kenneth Mees, director of the Eastman Kodak Research Laboratories, in making the announcement recently at Franklin Institute, characterized this as the most important photographic achievement since the kodak and film photography.

The outfit consists of a "taking" camera and a projector, both of which are illustrated below. The diminutive camera weighs only seven pounds and is said to be, relatively at least, as simple in operation as the usual kodak.

The film for the new movie outfit is 11/16 inch wide as against the standard width of 1⅜ inches, while each picture or frame measures one centimeter by ¼, as compared with the standard picture of 1 inch by ¾ inch. Five pictures on the small film consequently occupy the same length as two on the standard so that 100 feet of Cine Kodak film is equivalent to 250 feet of standard, and a 400-foot reel equivalent to the standard 1000-foot reel. The film is of the non inflammable type and coated with a special emulsion which enables the negative to be developed and then by a new process reversed to give a direct positive picture for projection.

The lens is an anastigmat working at f.3.5, permitting photographs to be made under poor light conditions. The finder is just above the lens and by an ingenious attachment changes the position of its image as the lens is focused. In this way the image is shown through the center of the field at all times. The lens has a focusing lever carried through to the back which can be focused for any distance from infinity to four feet. The diaphragm control is in the left hand corner and can there be read easily. In the center of the back is a footage indicator showing the quantity used, in feet. The crank turns nominally twice a second, taking pictures at the standard rate of 16 per second. The camera is daylight loading, the film being supplied in a special magazine. After exposure the film is removed in its magazine and sent to the laboratory for development.

The Kodascope, which projects the picture on the screen, is motor driven and is entirely automatic in its operation. Once a film is threaded the machine requires no further attention until the reel is exhausted. For home projection a lens of two-inch focal length is used the picture filling a 30 x 40 screen at a distance of 18 feet, and a 40 x 54 screen at 21 feet.



Projector for home motion pictures, the film shown actual size, and the camera set up ready for action

Why Is Talc?

FOR talcum powder, of course. But that is by no means the only use for it. There is talc on this page—in the paper, as filling. More talc is used in filling the pores of print paper than in camouflaging good complexions. Talc is also used as a filler for paint. Its discovery for that use was hardly accidental, yet it was not originally added with the intention of improving the paint, but of adulterating it. Later on, strange to say, paint chemists found it improved the paints for some purposes. Guilty consciences had been aching in vain, but now ached because a higher price had not been charged for the improved paint.

Talc is not at all rare. It occurs in many places, and the chief item that goes to make up the sales cost is caused by the preparation and marketing of the commodity. Found in its natural state it is a rock. Its chief physical characteristic is its soapy feeling, like graphite. The mineralogist calls it steatite, and it is a hydrous magnesium silicate. About 65 per cent of the world's talc is produced in the United States, the largest supply being in Vermont, which is so close to the centers of the paper industry that talc from other regions cannot compete.

The best grade of talc is used for talcum powder, which must be white—except in the case of talcum for men, which has a flesh color. There is nothing in talcum powder that is directly harmful. If earth is comminuted rock and if talc is a kind of rock, then talcum is only a kind of clean earth, to which boric acid is usually added to give soothing effect. It is interesting to note how many kinds of rock when broken up and crushed to the finest kind of powder, have the general semblance of talcum powder, although not the actual characteristics which are so necessary.

Not more than a generation ago, when the use of talcum powders became very general, it was said the skins of the growing generation would be ruined by its use. Yet the evidences of the eye say otherwise. The processes the natural product go through before it is passed over the druggist's counter insure that it is the cleanest of all dirt.

What Is Color?

Something About the New Theories of Ostwald on this Important Subject

By Ismar Ginsberg

COLOR we have with us always without it the world would indeed be drab and spiritless and human psychology quite different from what it is Every new theory which seeks to improve our knowledge of color or to perfect the classification and recognition of the numerous colors is worthy of serious consideration and study When such a new idea is propounded by a well-known scientist like Dr William Ostwald the German chemist its interest and importance are doubly certain The numerous discussions published since he first advanced his color theory in 1917 are sufficient evidence that this theory is a contribution to our knowledge of color science and well worth the space which Mr Ginsberg here gives it —THE EDITOR

LIGHT IS one of the many manifestations of energy In order that it be produced some other form of energy must be converted into light energy Excluding the sun our greatest source of light we have two principal kinds of energy on the earth which can be thus converted In the incandescent electric light or the electric arc electrical energy is transformed into light in the candle the kerosene lamp or the gas jet chemical energy is so transformed In both cases the change is indirect the original energy being first converted into heat energy and this to light Direct transformation of electrical and chemical energy into light is known but as in the phosphorescence of insect and bacterial life on a small scale as regards the resultant luminosity

Light travels from place to place with great rapidity—some 186,000 miles per second This characteristic light shares with certain other types of energy such as radiant heat and electrical waves all such are known collectively as electromagnetic waves In their passage through space filled as it is with all sorts of bodies these rays of light undergo changes in direction and intensity through contacts with these objects Some of these bodies like highly polished metallic surfaces throw the light back into the space from which it emerged This is reflection Theoretically if the surface were highly enough polished it could throw back all the light received so that the reflected beam would have the same intensity as the incident beam differing only in its direction But this theoretic perfection is in practice never attained Bodies vary in the amount of light they throw back into space according to the physical characteristics of their reflecting surfaces what is not reflected is absorbed or swallowed up increasing the temperature of the body or being otherwise converted

Other substances allow light to pass through them like glass or water according to degree they are called transparent or translucent In the course of such passage the direction of the light is ordinarily changed also This is refraction each body possesses its own individual capacity for refracting and absorbing as well as for reflecting

We have said that light is propagated in waves This applies to all electro-magnetic energy and light is distinguished from the invisible forms like the X ray and the electric current only by being of certain wave-lengths The eye is sensitive to electromagnetic waves of lengths between 00004 and 00008 centimeters anything below the one limit or above the other is invisible And within these limits, waves of all lengths are found, and all affect the eye but affect it differently The difference consists in the different sensations of color Light of a given wave length or of a given combination of wave lengths produces a given color sensation

We find it convenient to divide the visible spectrum or wave-length range into six sections calling these red orange yellow green blue and violet When sunlight in which no wave-lengths are missing strikes a body all these colors are present and if all are reflected the body will be of substantially the same color as the sun itself differing only in intensity If not all are reflected, we see the ones that are and of course fail to see those that are absorbed Thus, if a body is red we know that the orange yellow green blue and violet rays have been absorbed and the red reflected The exact range of color resulting is a function of the three properties of reflection refraction and absorption If all the light falling on a body is absorbed the resultant color is black or gray

There are various ways of classifying colors Ostwald starts with a very simple division White and black he calls the dull colors, the six hues of the spectrum listed above he calls the bright colors Within the dull series as within the bright all gradations are possible, and we have a continuous series, with black at one extreme and shading down through grays into white at the other There is just one way in which one dull color can vary from another in the percentage of black and white that it contains When two such grays are mixed we get a new gray brighter than the one and duller than the other and for which a place can be found in the series Hence this series of dull colors is uni-dimensional

Black has ordinarily been called "no color" and taken to denote the absence of color Likewise, white, being constituted of all colors, may also be considered as no color A white body is assumed to reflect all the light that strikes it There is no absorption and hence there is no color A black body absorbs all the light that impinges upon it and reflects none, therefore there is absence of all color Theoretically this is true, but there is no white that will reflect 100 per cent of the light and no black that will absorb 100 per cent of the light We often hear of a whitest white until a whiter one comes along and displaces it from its position of eminence The same fact holds good for black But inasmuch as some white must be taken as a standard of comparison a choice must be made of the whitest white Pure barium sulfate is accordingly taken as the 100 per cent perfect white, the white which reflects all the light that strikes it

From a practical standpoint it is equally incorrect to state that black denotes absence of all color For one black is blacker than the next and the blackest black which is assumed to have no color at all may be found to possess some slight trace of color when compared with another new black Furthermore as the eye is not absolutely perfect and as its sensitivity is not infinite absence of light as defined by the sensation produced in it, is relative only Even the deepest black would exhibit traces of color would reflect a little light if our eyes were sensitive enough to detect it.

It is accordingly evident that all the colors of the gray series can be easily distinguished from one another by their brightness in other words by the percentage of light that they reflect, based on blanc fixe as the standard This gives us a very convenient way of classifying and identifying the grays For example gray 95 is the designation given to the color that reflects 95 per cent of the light striking it. Such a color is white and is made from the purest zinc oxide Gray 80 is the color given by the purest grade of chalk. This color already possesses a yellowish cast All grays which reflect less than four per cent of light may be considered blacks and those that reflect more than 80 per cent of the light may be considered as white.

The bright colors are the ones that interest us most. The continuity of the spectrum might lead us to infer that these, too, constitute a uni-dimensional series The fact is however that mixtures of several different wave-lengths usually produce a color sensation quite different from that given by any simple wave-length. We find, indeed, that the bright colors constitute a three-dimensional series or continuum. First, we may vary them by mixing them with one another in any desired proportions. Second, having got any of these combinations, we may mix it with any given tone of the white-gray black series. Finally having selected the two colors, one bright and one dull, to be thus mixed we may effect the mixture in any proportion. So classification and identification of the bright colors is far from the simple matter which it is in the dull series.

We are all familiar with the fact that the red shades into orange, orange into yellow and so on clear through to the violet Not all of us, perhaps, have realized the significance of the further fact that violet can be blended into red. This really means that the spectrum may be arranged in a circle as well as in the straight line into which it is spread out by the ordinary prism or by the rainbow We can break into this circle or "start" the circle at any color whatever and pass clear around to return to the original color Quite arbitrarily, Ostwald starts the color circle with the purest yellow, containing no trace of orange or green, and passes around in the direction that takes him first to green, and then through the blue, violet red and orange back to the yellow

From the color circle we can pick out the colors that stand directly opposite one another These supplementary colors if mixed optically by the rotation of a disk painted in equal halves with the two colors, or mechanically by mixture of pigments, will always give a pure gray This result is not obtained by any proportion whatever of the two colors, but only when they are mixed in a certain definite ratio known as the saturation ratio Incidentally it is obvious that the saturation ratio holds good only if the colors are pure hence there is afforded a very simple means of testing the primary colors for purity

Ostwald s color circle is divided into 100 equal parts. If we draw the diameter joining the pair of supplementary colors yellow-blue, we find in the one half the colors yellow orange red, violet and ultramarine (naming them in order opposite to the usual one) In the other half will be found the blues and greens. Furthermore the colors of each semi-circle are so arranged that the mixture of two of them will give the color that stands halfway between them on the circle

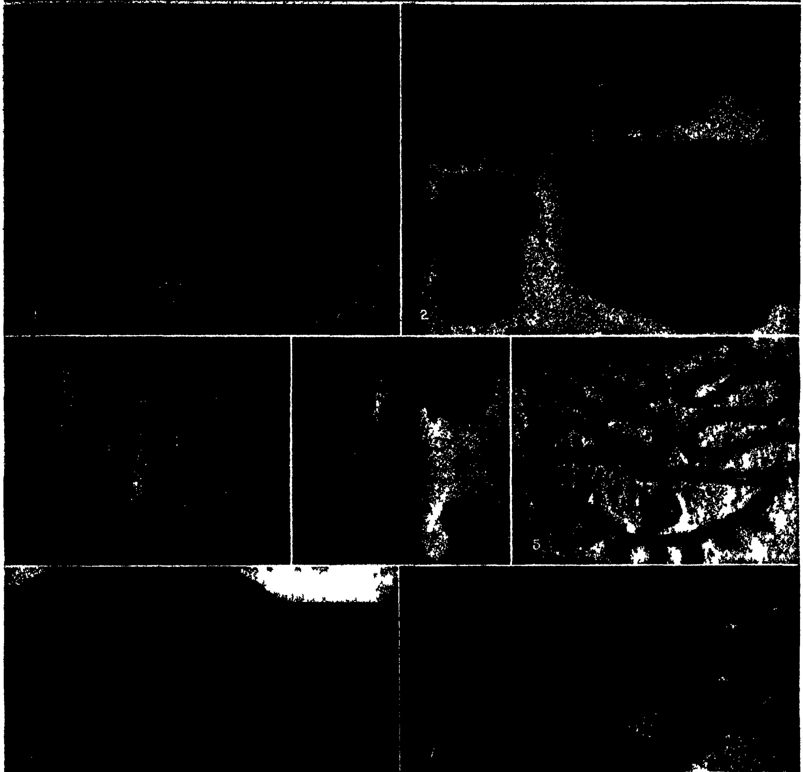
It is obvious that there is a certain arbitrariness in this arrangement, to the extent that one might stretch out the yellows and reds to occupy a full semi-circle, rather than so stretching the blues and greens. Ostwald s distribution is obtained by giving equal parts of the circle to equal differences in wave-length which seems to be the only method of a priori determination that is open and the results indicate that it is the proper distribution

When we attempt to use the circle as a means of indexing the colors, we realise that it is continuous, while any system of indexing is discrete necessarily But if we take 100 shades at equal intervals around the circle we find that these are at sufficiently small odds with one another to make, themselves a circle that will stand before the eye as almost continuous This selection is made, and the colors given numbers from 00 to 99. The shades from 00 to 24 then correspond to the colors ranging from sulfur yellow to cinnabar red 25 to 49 from cinnabar red to ultramarine 50 to 74 from ultramarine to blue green, and 75 to 99 from blue green back to sulfur yellow—again in opposite order to the usual arrangement of the spectrum.

When the dull color white, is added to any color tone, which is the pure fundamental bright color containing no dull color then there are obtained the light-bright colors. Any color of the color circle may be converted into a light-bright color in this manner For instance take a red, which has the number 21 in the color circle. The primary designation 21 means the pure color tone red Then 21.75 would indicate the same red with a purity of 75 per cent, the remainder being white. On the other hand the pure color tone can be mixed with black then we have a series of dark-bright colors. Similarly, when the color 21 is mixed with 25 per cent black, then the same designation 21.75 would indicate a red that is 75 per cent pure, the remainder being black. The designation is therefore incomplete, for not only must the [illegible] and its purity be denoted, but the nature of the [illegible] as well, that is, whether it is black or white [illegible].

A color that contains both black and white in addition to the pure color tone is [illegible] [illegible]

(Continued on page [illegible])



Photos, courtesy "Illustrated London News" and the British Museum

THE excavations carried on this year by a joint expedition from the British Museum and the University Museum of Philadelphia under the leadership of Mr C. L. Wooley, has resulted in the discovery of treasure-hoards among the ruins of the temple of the "Moon-God," which are most remarkable as showing a very highly developed civilization Some of the remains date from 6000 B. C The ancient city was 125 miles northwest of the Persian Gulf in the Kingdom of Iraq, which the British wrested from the Turks during the World War, thus rendering exploration possible. The spot is named Tell El-Mukayyar and some of the buildings excavated in 1919 date from 2800 B C., or nearly 1500 years before the time of Tutankhamen

The articles of jewelry which we show (Figs. 3, 4 and 5), while of much later date, are splendid examples for the period, and we may expect to find Chaldean motives in jewelry the same as we now have Egyptian jewelry of modern fabrication.

Chemistry has proved to be an indispensable handmaiden of archæological research here for numerous inscribed tablets have been found but they were in bad condition and needed careful treatment before they could be read They were of unbaked clay and consequently very liable to crumble to pieces Mr Wooley applied an elaborate method of baking and treating with preservatives so that the cuneiform inscriptions are now legible, as indicated in Figs 1 and 2 showing the tablets before and after treatment Most of those which have now been examined date from 2000 B C and relate largely to matters of money and accounts.

The explorations at Ur are particularly interesting because it was the birthplace of Abraham and therefore intimately bound up with early biblical history Abraham was born about 2000 years B C and at that time Ur was situated on the Persian Gulf But since that time the Euphrates has carried down enough silt to throw the ancient city far inland It was a great maritime emporium enjoying a large commerce. Besides, it was situated in a marvelously rich country Chaldea was about the size of Scotland but the "Ships of Ur" navigated all the known world Abraham was not a Jew by birth but was the son of Terah, an idolater However Abraham was chosen as the fountain head of a stream of descendants that has flowed on for 4000 years without a break. The story of Abraham in the Book of Genesis becomes very real in the light of the new discoveries Abraham proceeded from Ur to Haran and from there to the land of Canaan

The bottom views, Figs 6 and 7 show part of the excavation and one of the uncovered tesselated floors.

UR OF THE CHALDEES: THE BIRTHPLACE OF ABRAHAM

The laboratory for conducting cement tests

Where balloon fabrics are tested by the Bureau

Uncle Sam's Question-and-Answer Office

The Bureau of Standards, and It's Bearing upon Everyman's Business Problems

By S R. Winters

HOW can the dentist determine the wear and tear on false teeth, what amount of energy is absorbed by varying types of automobile tires, enumerate the different kinds of rare sugars, what temperature produces the strongest brass, how thick is molasses and what is the relation of density to quality, and how can a business man apply a motor-driven letter opener in speeding the clearance of his morning's mail?

No, this is not a list of conundrums for mere speculation or fictitious puzzles for fireside fancies. Rather, these were definite problems explored and solved recently by the National Bureau of Standards—and these are only six of 124,668 tests by actual count, more or less satisfactorily conducted during one year By classification, 110,468 scientific observations were made for the government and 14,200 for the public The preeminence of the demands for Uncle Sam was partially attributable to the exigencies of war For instance, it was imperative to develop a sound ranging device for the location of a three-inch battery, three miles away, accurate enough to fire Civilian problems could wait solution.

Now the battle flags have been furled, the question arises how can the individual, the manufacturer, the business man, the inventor, the scientific society, public utility corporation, and the municipality avail themselves of the practical utilization of the Bureau of Standards in solving their knotty, every-day problems? Popularly termed, this government bureau is capable of applying the yardstick and the thermometer to American factories and industries—with the ultimate results of eliminating waste, facilitate precision in science, and obtain high utility in products of industry by indicating an attainable standard of quality

Perhaps millions of American citizens have never heard of this branch of the U S. Department of Commerce—therefore, a paragraph as to its location and organizations is not amiss.

Not altogether dissimilar to the college that chooses rural scenes for its campus as a way of removing its students from the temptations of the white lights of the city, the Bureau of Standards selected seclusion as a guarantor of freedom from mechanical disturbances and vibrations. Three and one-half miles from the White House, it is situated on a commanding promontory 350 feet from the Potomac River. It is reached by the Chevy Chase Lake car-line. Fourteen buildings, embracing 24 acres of ground, constitute its outward material equipment The Bureau employs approximately 1000 persons, compared with 500 prior to the war

Scientifically expressed, the Bureau of Standards classifies its function into clearly-defined divisions Standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice The public, however, can best visualize its capabilities and opportunities of service by briefly summarizing a few of its achievements in 1919

States and municipalities can call upon the department to compare weights and measures. A revised edition of Circular No 3, "Design and Testing of Standard Mass," has been published Investigations of mine scales are being conducted in the coal fields of Ohio, West Virginia and Kentucky. Seventy-eight different railroads, in 32 states, had their railroad-track scales tested Standards of gas service were evolved for 15 cities.

Telephone service, the bugaboo of utility commissions and public alike, is the object of extensive investigation Street railways and electric lighting companies also bring their problems to Washington for solution. A three-wire power-distribution system was suggested and adopted by the street railway company of Wilmington, Del. Recently the Bureau was wrestling with the problem of corrosion of the lead cable sheaths of the electric company in St. Louis.

The Bureau of Standards has the only "altitude laboratory" constructed in the United States. The small room, with reinforced-concrete walls, is strong enough to withstand the pressure produced on the outside by exhausting the air within to a pressure as low as one-third atmosphere Aviation engineers are here testing the units of mechanism operating under conditions permitting of careful scientific measurements. A device has been developed for measuring the rate of altitude on an airplane.

The Medical Service of the War Department and the general public are using 20 so-termed rare sugars. The Bureau is conducting investigations that will ultimately disclose scientific data on the rare sugars.

A controversy has arisen between buyer and seller of blackstrap molasses relative to the quality of same—the Bureau of Standards has consented to act as referee. A device for determining the density of molasses has been developed—the value of the product being predicated upon its thickness.

Hitherto the United States has imported its clay products from foreign countries. Cooperating with a potters' association in East Liverpool, Ohio, the Bureau has completed satisfactory tests whereby white-ware pottery can be made altogether from American clays under commercial conditions. Of 46 compositions, more than half proved to be satisfactory and the American housewife can use tableware made from domestic clay

Optical glass, formerly imported from France, Germany and England, is to be manufactured on a commercial scale in this country—thanks to the efforts of the Pittsburgh laboratory of the Bureau of Standards.

Mr Business Man, is your mail so heavy as to warrant the use of a motor-driven letter-opener? If so, write the Bureau of Standards, Pierce Mill Road, Washington, D C., and inquire about the ingenious instrument which saves the time of an employee previously assigned to this task. The new machine is used to photograph important incoming mail, using for the purpose a motion-picture film. The photographic reference record of incoming letters, by means of a projector, is adapted to flash the image.

Dr George Kimball Burgess has been appointed director of the Bureau of Standards, United States Department of Commerce, succeeding Dr. S. W Stratton, who resigned the directorship to become president of the Massachusetts Institute of Technology The new director has been identified with the Bureau of Standards for 20 years, and since 1913 has served as Chief of the Metallurgical Division.

High temperature measurements is the outstanding scientific contribution of Dr Burgess, he being the author and translator of a number of books on this subject. His capacity for organization and leadership is responsible for the present Division of Metallurgy at the Bureau of Standards, composed of a staff of 58 persons. The newly installed director of this branch of the government service personally received the silver medal and the Bureau of Standards was the recipient of the gold medal from the Panama-Pacific Exposition of 1915. The activities of the Division of Metallurgy range from the mixing, melting and casting of, to the chemical, microscopical and physical tests of metals.

Sixteen by twenty-four inch rollers used in the metallurgical division, for studying the effects of mechanical working upon metals

1, 2: lower and upper halves of indicator body 3: water jacket. 6: screws for holding halves together 7: air inlet connection. 8: cooling-water inlet and outlet tubes. 10: electric terminal. 13: mica washers. 14: brass washer 17: spark-plug gasket. 18: insulating wire. 19: small air-tube. 20: adjuster for connecting small tube to larger tube

Assembly at the spark-plug for carrying the engine pressure to the indicator

For Learning Engine Pressures

A HIGH speed indicator suitable for measuring pressures in gasoline engines or other units of mechanism where expanding gas is used has been designed by the U. S. Bureau of Standards. The device consists of three parts—the pressure balancing element, the timing element, and the coordinating apparatus.

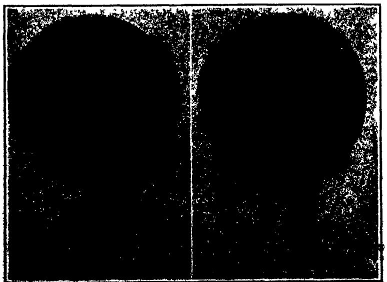
The balancing unit contains an extremely thin metallic diaphragm, the motion of which is limited to a few thousandths of an inch by two corrugated and perforated surfaces which serve as supports for the diaphragm. The latter could not withstand the pressure without these props. The tiny space below the diaphragm is in contact with cylinder of the engine through a group of small water-cooled tubes.

The space above the diaphragm, larger than the opening below, communicates through a small tube with a source of controllable and measurable gas pressure. The center part of the upper support is replaced by an electrode which is insulated from the remainder of the indicator and is so situated that the diaphragm will form contact with it when the former is deflected up almost enough to be held from further motion by the upper support. When the pressure in the cylinder is slightly greater than the balancing pressure, the diaphragm is forced against the electrode, thereby completing the circuit and providing a positive record.

The timer is composed of a rotating contact of one-half degree and another contact which can be set at any desired angle. The coordination equipment has two parts, the electric circuit and the pressure circuit. The former is composed of a series of connection, battery, telephone receivers, timer, and indicator. The latter consists of a source of gas under pressure and a source of vacuum, with valves and gages for supplying, controlling, and measuring the pressure applied to the top of the diaphragm.

Enlarged view of the delivery end of the rivet gun

Under operating conditions, the pressure and the angular setting of the timer can be varied until the phones indicate by the ceasing or beginning of the clicking that the point has been reached where the pressure and the angle correspond to a point in the engine cycle. The pressures and corresponding angles are plotted to form the desired diagram. The indicator does not make a complete diagram for an individual cycle but is used to measure the pressures in consecutive cycles at certain consecutive points in those cycles, thereby building up an average diagram.



The single-point timer for closing the indicator circuit during but one degree of the cycle and at a predetermined position of the crankshaft

The Rivet Gun and Its Role

THE erection of a large steel skyscraper is a familiar sight to most city dwellers and all visitors to a city such as New York have been interested spectators. One of the usual sights is the delivery of hot rivets by the rivet heaters to the erectors of the steel furnace work, the rivets are usually thrown or tossed to the workmen by means of tongs and the hot rivet is caught in a tin pail or can. Such workers have become very dexterous and few rivets are lost, while accidents in which workmen on a lower level are struck by a falling rivet are so rare as to be a cause of suspicion when they do occur.

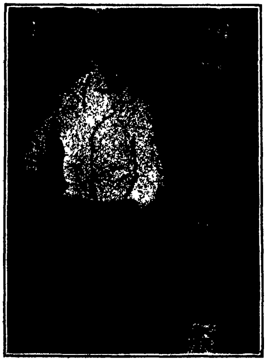
A device has been perfected, however, which does away with this cumbersome method of delivery. It is known as a "rivet gun," and with its use the hazards of rivet handling are reduced to zero.

The illustrations show the component parts of this rivet-passing outfit. They consist of a compressed air tank, a foot treadle mechanism to release the air, a compressed air inlet shown at the right side of the tank, a head or body into which the rivet is inserted, metal tubing for transmitting the hot rivets and a receiver into which the rivets are shot at the other end.

The gun and the forge are conveniently located in an out-of-the-way place and the tubing led to the job. As each rivet is heated and ready to be passed it is set by the heater on a valve provided in an opening contained in the head of the gun. The rivet opens this valve by its own weight and enters the machine. The valve recloses automatically and the rivet is sent on its journey simply by pressing the foot treadle. The latter operation releases the compressed air, which has been supplied to the tank, into the head of the machine and speeds the hot rivet through the flexible tubing. The rivet is shot into a receiver at the other end, where the holder-on removes it with his tongs and inserts it in the hole.

The rivet gun has a distance capacity of 125 feet delivering rivets up or down at the rate of 50 feet every three seconds. It is claimed that the gun has even exceeded this performance, shooting rivets 180 feet in nine and a fraction seconds without subjecting the rivets to any material reduction in temperature.

One of the outstanding advantages afforded by this equipment is that it eliminates the necessity of placing rivet forges in closed compartments, keeping the fires and their fumes out of closed places to the benefit not only of the riveting gang, but also of other workers there. Delivering heated rivets to points of operation difficult for direct passing facilitates work in inaccessible places and passer boys are not needed. As to air consumption, data furnished would indicate that this equipment does not materially increase the total requirements of compressed air per rivet on new construction and a substantial reduction in rivet passing costs is claimed. Prevention of a high percentage of accidents in bridge building and structural work caused by faulty rivet passing is also a feature. The equipment is particularly adaptable to building steel masts in place.



Getting rivets on the job without plucking them out of the air

Composition, Purification and Certain Constants of Ammonia

SEVERAL years ago at the request of the refrigeration industries, the Bureau of Standards undertook an extensive investigation of the properties of anhydrous ammonia. Upon the results of this investigation will be based the compilation of accurate tables for engineers' use in designing and studying the operation of refrigerating machines.

All of the properties necessary for such a compilation have now been determined within the range of pressure and temperature ordinarily encountered in practice. The most refined physical measurements have little real value, however, unless assurance is given that the material used is of high purity. The necessary information on this point is contained in Scientific Paper No. 465 on the "Composition, Purification and Certain Constants of Ammonia," which has just been issued.

Analyses of a number of standard American brands of commercial ammonia now upon the market indicate that they are more worthy of the designation "chemically pure" than many of the more common chemical reagents. Tests conducted at this Bureau showed that most commercial ammonias contain less than 0.1 per cent of impurities.

This paper can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy.

A Readable Manual of Seismology

NOT until sixty years ago did earthquakes become the subject of exact investigation and seismology is really so new a science that its treatment is not yet precisely defined. The more credit is therefore due Dr. Charles Davison for the judicious selection and orderly arrangement of material in his interesting Manual. The Macmillan Company have kindly allowed us the use of a few of the numerous interesting facts found in the work.

When the thunderous passage of an express train makes the ground tremble beneath our feet we have a momentary sense of insecurity that in the hypersensitive may verge on awe. It is easy to see how violent disturbances of the crust of the earth without visible cause should have been attributed by our superstitious ancestors to supernatural agency. Priestley's attempt to trace them to an electrical origin was a failure. Even today it is impossible to say just what form the initial displacement takes for it is masked by a mile or more of earth and rock. The seismologist takes for granted this disturbance at what he calls the seismic focus and studies only its effects. These are primarily a series of waves surging outward with great velocity in all directions; every particle of rock encountered is shaken rapidly to and fro and it is this vibratory movement which reaches our consciousness. If it is sufficiently violent it may be continued up to the surface with force enough to cause a mass-displacement of the crust.

The instrument generally known as a seismograph is the pen with which the earthquake is made to write the story of its life for us to read. One of the earliest forms of this instrument was Babbage's bowl of molasses; a shock caused the fluid to climb one side of the bowl and the position of the stain indicated roughly the direction and extent of motion. In his illuminating chapter on seismographs Dr. Davison resolves them into their basic components describes the way in which they work and pictures representative instruments of today.

The vibrations accompanying even a slight shock are complex. There is usually a displacement of the ground in some definite direction and also a rotation about some definite line. If we take three axes at right angles to one another one vertical and the other two horizontal the displacement may be resolved into three component displacements along these axes and the rotation into three component rotations about the same lines. But no single seismograph capable of recording all six components has yet been devised. Fortunately rotary movements are of slight consequence and efforts have been concentrated on recording the horizontal and vertical movements of the ground; even here no single seismograph is sufficient, near and distant disturbances require differently constructed instruments.

Three parts are essential to the seismograph: the steady mass, a certain point or line of which remains, at least theoretically, always steady; the frame or support from which the steady mass is suspended, and which partakes of the movement of the ground; and the recorder—a lever, or a beam of light that magnifies the displacement, and inscribes its record on a drum or plate that is usually in continuous motion. Modern instruments add a damping device to check any oscillations that the steady mass may acquire. The principles of construction and operation are made very clear by accompanying drawings and both mechanical and photographic methods of registration are explained.

Of the many different types of vibrations co-existing in a great earthquake, some elude our observation by reason of the smallness of their amplitude, others by the length of their period. Generally we first become aware of a low ominous rumbling sound as this grows louder faint but rapid tremors like those caused by our hypothetical express train at not too close quarters, are felt; sound and tremors soon merge into vibrations not exceeding two or three per second and in violent disturbances each vibration may last a second or more; deep explosive crashes may be heard before the shock subsides and the sound dies away. A seismograph if within the disturbed area clearly registers the preliminary tremor, the principal portion and the end portion as these three phases are called. To studies of the nature and intensity of earthquake motion as revealed by seismographs are added calculations of the maximum acceleration from the overthrow of columns of known dimensions.

Some earthquakes are accompanied by noises that resemble a roaring wind, the boom of a heavy gun in the distance, the trampling of many animals or the rending of huge masses of rock. These sound phenomena have been duly classified and studied and maps on which the isacoustic lines have been plotted furnish material from which significant deductions are drawn.

Most spectacular of course are the deformations of the crust that accompany great earthquakes. It will astonish the average reader to learn that these crustal deformations are not caused by the earthquake but rather are themselves the cause of the shock. The Californian disaster of 1906 has been studied in the greatest detail, and the San Andreas fault traced, with [illegible], where it takes a [illegible] course, for a distance of more than 300 miles. Some considerable horizontal displacements were noted that measured from eight to fifteen feet. A new [illegible] survey disclosed the fact that both sides of the fault were displaced, and that the movements were not confined to the immediate neighborhood of the fault.

In the study of earthquakes, geographical distribution ranks high in importance. Taking area into consideration, for every earthquake felt in Great Britain there have been 50 in Japan and 1[illegible] in Greece. Indeed the seismic map of Japan is so spotted that it looks like a leopard's skin. From such maps scientists have deduced certain laws of seismic distribution. Briefly they conclude that earthquakes are numerous where the gradient of the surface is considerable, and rare where the gradient is small.

In these few descriptive paragraphs it has been possible only to touch upon the more popular aspects of the subject, but Dr. Davison's Manual, while eminently readable, does not confine itself to these. He sets before us the problems of the seismic focus, explains the propagation of earthquake waves, examines the frequency and periodicity of earthquakes, and discusses the relations between tectonic and volcanic earthquakes, while the text throughout is strengthened by illustrations, maps and diagrams to the number of a hundred. The Manual is a notable accession to the Cambridge Geological Series.

A Sugar-Coated Dandruff Cure

DISGUISING a dandruff cure as a man's beauty lotion for keeping the hair slicked back shiny and sleek is a new way to combat a disease that, according to Dr. Vincent Coty of Forest Hills, N. Y., is making us a nation of 'head scratchers.' The sufferer from this trouble will perhaps feel that it is of more importance than he had suspected when he learns that the scientific name for it is 'Seborrhea Sica,' which makes it appear to be a really serious matter. There are numerous theories to account for dandruff but none have been given the seal of finality by the medical profession. Some believe it is caused by a microorganism. It is known to be more prevalent among brunettes than blondes. One remedy is resorcin and quinine in an olive oil base. This not only is a treatment for dandruff but acts as a slick for the hair as well. Many who would balk at using a preparation obviously sold as a cure for dandruff will accept the remedy if it is camouflaged as something else. Hence the growing popularity of shining and sleek hair.

Internal Secretions and General Biology

THE complex operations of the organism were long supposed to be explicable wholly through the interplay of the stimulative and inhibitive actions of the nervous system but more recently it has been discovered that an important part is played by certain chemical agents the internal secretions. It seems quite possible indeed that the substances produced by the internal glands and carried to all parts of the body by the circulatory system may operate upon the same physical principle upon which is based nervous stimulation. On the other hand it seems certain that the chemical coordinations resulting from the action of these secretions differ in some respects from those produced by the nervous system. The latter are instantaneous and often of very short duration. The former are slow since they are the result of the action of reagents which must be carried by the blood to remote parts of the body and continuous since their apparent functions is the maintenance of uninterrupted relations between the various organs.

This understood we may next inquire whether there is any generally applicable explanation of the fact that the internal secretion of a given gland exerts an effect upon some one tissue of the body rather than upon some other. For example adrenalin produced by the suprarenal gland exhibits a special affinity for the sympathetic nervous system and this affinity has actually been traced to its embryonic origin. But we also know that there are other elements having a common embryologic origin, which are later widely differentiated.

This line of thought is being pursued by numerous investigators but there are many other paths to be followed as well. These appear to be particularly numerous and diverse when we abandon the comparatively restricted field of the higher class of mammals, and direct our attention to the internal secretions throughout the entire series of animals, and particularly to those found in the invertebrates.

The following constitute the chief preliminary facts known through study of the human case. Degeneration or absence of the thyroid gland causes profound alteration in the human form. Cretinism a standard type of deformed idiocy is an example of this. When the thyroid extract is administered to a cretin the body grows taller the bones are filled out and the lines of the nose, eye-socket, mouth etc are modified so as to add intelligence to the facial aspect. Deficiency of the thyroid is also responsible for a swelling of the skin and the extremities, falling hair etc.

Even more striking is the influence of the pituitary body the first of the ductless glands to win general recognition. To its maladies are ascribed acromegalism and gigantism. Acromegaly is a malady whose external symptoms comprise a deformity of the skull, enlargement of the entire skeleton of the head, and change of shape in hands and feet. Gigantism is marked by abnormal height of body, an essential symptom being increase in the length of the bones of its lower portion. It also involves enlargement of the facial skeleton, forward thrust of cheek and eyebrows, curvature of the spine, etc.

Both these deformities are traced to hyper-functioning of the pituitary body. Imperfect function, on the other hand, leads to dwarfism and obesity. In the case of pituitary obesity, there is continuance of the infantile character of the external form, with great development in the layers of fatty tissue and marked decrease in size of the genitals. Contrary to the case with the thyroid this under-functioning of the pituitary may be accompanied by normal intellectual development.

As regards the suprarenals, we find here disturbances from the normal only in the direction of hyperfunction. Premature sexual maturity with undue development of the secondary sex characters is accompanied by suprarenal tumors, which are now known to stimulate the functioning of these glands beyond the normal point. It is to be noted that in all the cases so far noted glandular abnormality is accompanied by alteration of the sex glands in some fashion and it is not yet certain how much of the latter is effect and how much actually cause. All the glands seem part of the same general system.

The influence of chemical substances in general upon form is in fact, supported by many observations. The term "chemical substances" is here substituted for "inner secretions," in order to emphasize that the problem is of far greater generality than might be supposed from the special cases in which it first comes to our attention. Loeb's work in parthenogenesis has taught us that the very first impulse toward the creation of form may come from comparatively simple chemical stimulus. Experiments upon qualitatively insufficient nutrition confirm how greatly growth is dependent upon minute quantities of hitherto unknown chemical substances.

Perhaps the most remarkable phenomenon observed in this connection is the demonstrated fact that living organisms which, when left to themselves, would linger in a lower stage of development, may be made to progress into a higher stage merely by administering thyroid preparations in the form of an addition to their food supply. A case in point is that of the axolotl, which when kept in a [illegible] retains its gills and remains a water animal. But if thyroid preparation be added to the water in the bowl, the gills atrophy, there is a change in the form of the body and the tail, and the former water animal becomes a land animal. We must not overlook, however, that the potential ability to undergo this change is present in the animal from the start [illegible] the experiment a [illegible]. Perhaps it would not be [illegible] the probabilities if we [illegible] phenomena as [illegible] recent [illegible] (Paris) and Dr. [illegible]

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

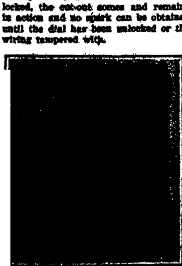
The speedometer that acts as a governor

Something New in Speedometers

POSSIBILITY of improvement in the speedometer has perhaps not impressed itself upon the average driver, but the product not being marketed by a Chicago firm indicates that this possibility exists. As far as the mechanism indicating speed, trip mileage and total mileage is concerned, this speedometer is no different from its predecessors. But it goes far beyond that.

The dial at the bottom of the instrument may be set for any desired speed, and then locked or left unlocked. In either event, as the car comes within two or three miles of the indicated speed, the signal light at the right will flash; and if the acceleration then continues until the car actually reaches the dialed speed, the ignition is cut off. If the dial has been locked, there is no escape from this; if it has been left unlocked, the driver may meet an emergency by a simple twist of the key, setting the limit forward to any desired point. Finally, the instrument may be adjusted so that the signal light alone works, without the ignition cut-out; or the cut-out alone, without the light, or both together, as described above. Ordinarily, when the ignition cut-out functions, the engine will go dead and stay dead until the car-speed falls below the dialed figure, and at this point the cut-out will go out of action and the rolling car will start the engine, just as in braking with the engine. If it is desired to prevent this, the dial may be left unlocked, and turned back to zero as the cut-out comes into action.

This suggests a further use of the apparatus as a preventive of theft. Obviously if the dial be set to zero and locked, the cut-out comes and remains in action and no spark can be obtained until the dial has been unlocked or the wiring tampered with.



[illegible] for the [illegible] pen

Gravitation Truly Constant

MORE than one investigator has been led to the conclusion that the Newtonian constant of gravitation changes slightly as the attracting bodies are heated. In the Proceedings of the Royal Society for October 2, 1922, Messrs. P. E. Shaw and N. Davy, who had previously noted an increase of gravity with rise in temperature, now report that with improved suspension arrangements the difference disappears. This probably has a wider significance than would appear from its mere application in correction of the authors' previous results. The SCIENTIFIC AMERICAN has always expressed the opinion that observed variations of the gravitational constant as a function of temperature, or pressure, or of the chemical constitution of the gravitating bodies, have been due to observational errors or inadequate data.

The One-Hand Grease-Gun

LUBRICATING the automobile with one hand is the latest thing, made possible by use of the grease-gun illustrated herewith. "A ton of pressure" is the manufacturer's claim, but he does not specify whether he means total or per square inch. We assume that he means the latter, and that the true content of the claim will be duly appreciated by every prospective grease-gun user. The tool seems a decidedly usable and workmanlike affair. A single filling is said to be enough to lubricate the ordinary chassis two or three times, but just how many grease cups the "ordinary chassis" is conceded to carry is not indicated.

Reducing the grease-gun to its simplest terms

A Filling Station for Fountain Pens

WHAT do you do when your fountain pen runs dry at the most inconvenient possible moment—as it always does? If you are a student at the University of Chicago, you patronize the nearest filling station, the campus is supplied with these quite as freely as is the Lincoln Highway with filling stations for the tourist. A penny in the slot operates the machine, and enables the owner of the most voracious pen to appease the thirst of his instrument. The machine works with self-filling pens and with the old style that fills from a dropper—provided the user has his own dropper. The dropping of the coin and the turning of the handle releases ink from the reservoir, and the fluid flows into the right-hand well, whence it can be sucked up by the pen itself or by the dropper. A slot in the upper left-hand corner of the outfit contains a wiper with which any damage done by spilling or slopping may be repaired. If one drink turns out not enough, a second penny will, of course, turn the trick.

Making the Chauffeur's Cigar Harmless

WE once brought down wrath upon our head by suggesting that a cigar lighter on the dashboard of the modern automobile was not enough of an absolute necessity to justify the car manufacturer in setting it down as one of the major sales points of his latest model. The reaction of the manufacturer of the lighter was substantially to the effect that we were the only automobile owner in the world who did not smoke, and that our viewpoint was accordingly a frightfully distorted one. So we illustrate with studiously neutral comment the device that makes it possible for the chauffeur to smoke without putting out the eyes of his passengers. No, on further consideration, we withdraw this neutrality in favor of emphatic endorsement, for we have driven 100 miles beside a persistent smoker, and arrived sightless at the destination. The device illustrated consists of a gauze cylinder that is fitted about the cigar, and prevents ashes and sparks from flying about. In all seriousness, it strikes us as a highly sensible scheme.

Safety for the person who has to ride with a smoker is secured by this gauze cage for the cigar

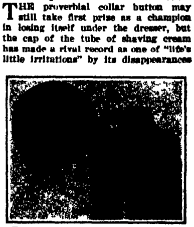
The Normal Helium Atom and the Quantum Theory

AFTER a brief critical survey of existing quantum theory models of normal helium, a study is made by J. H. Van Vleck, in the *Philosophical Magazine* for November, 1922, of the model suggested by E. C. Kemble (*Science Abstracts*, No. 1680, 1921), in which the two electrons are arranged with axial symmetry, the one symmetrical type of which the energy had not been computed. The mathematical analysis, necessarily laborious, was rendered greater than in the case of an astronomical orbit, owing to the relatively large perturbing forces of each electron upon the orbit of the other. It occupied about six months and is reproduced in all essential details. The checking of the accuracy of the calculations by the test of constancy of the energy of the system, commonly used in the astronomical case, would here have involved the extremely laborious calculation of the coefficients of the various periodic terms of the Fourier expansions of the kinetic and potential energies. A much easier method was furnished by the fact that in motion under the inverse square law the average absolute value of the potential energy is twice the average kinetic energy. Since the average value is simply the constant part of the Fourier expansion, and since a power series development is unique, the coefficients of like powers of the parameter must be identical if the computations are correct. There is absolute agreement in the first three terms, while the small errors in the fifth decimal place in later terms are insignificant, and due mostly to neglect of the third and higher powers of the perturbations. The model is a sort of hybrid of the Bohr and Langmuir models. It may be approximately described as the projection of a sine curve on a barrel-shaped surface of revolution, the two electrons always being on opposite sides of the barrel.

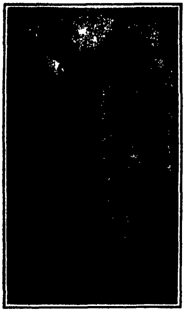
The chemical stability of helium indicates a very simple and symmetrical arrangement of its pair of electrons, but all the models possessing this property now appear to have been tried and found wanting. A reformulation of the quantum conditions is one alternative and the author considers several of such. But he finds each one precluded by incompatibility with experimental results. A. H. Compton (*Science Abstracts*, 908, 1921) concludes that the spiral tracks of beta particles indicate the field of an electron not having the spherical symmetry required by Coulomb's law, and he suggests the beta particle acting as a magnetic doublet as well as an electric charge, but if the helium electrons did so act, their strength, to reconcile the calculated ionization potential of the model, would be quite incompatible with observed molecular magnetic moments and would invalidate the classical theory of X-ray scattering. Crowther and Schonland (*Science Abstracts*, 1320, 1922) suggest that some modification of the law of force at *very small distances*, either between two negative electrons or an electron and a nucleus, appears to be demanded by their experiments in the scattering of beta particles.

The Cap that Can't Lose Itself

THE proverbial collar button may still take first prize as a champion in losing itself under the dresser, but the cap of the tube of shaving cream has made a rival record as one of "life's little irritations" by its disappearances



The cap that is bound to stay with its tube



A mica condenser for radio work, of huge proportions

down the lavatory outlet. Man had to devise something better to save his temper and the result is that the manufacturer of one brand of this daily toilet necessity has put it into a tube whose screw cap is hinged as well. You can't lose it unless you mislay the entire tube. For further convenience the cap is designed so that it may be hung upon the wall by a little screw hook which accompanies it.

The Lightning Change Screw-driver

THE question of having the right tool at the right time has been partially solved by a western manufacturer who has produced the very ingenious magazine screwdriver illustrated.

It is absolutely a new idea and a departure from the usual magazine screw driver in that the blades issue from the chuck into the working position without leaving the magazine. It contains three sizes of blades that are designed to give it a wide range of use. The blades are always contained within the magazine and are not removed; consequently they are not lost or misplaced as is the case with most magazine screwdrivers.

The basic principle of this new tool is that the blades are selected and issued by gravity by tipping the tool. The blades are indexed to correspond with numbers on the shell and the operator is always sure of getting the right blade by simply holding the desired number up when tipping the tool as indicated in the illustration.

This new tool will be found useful by mechanics, machinists, carpenters, sportsmen, electricians, automobile owners and in fact anyone who ever uses a screwdriver.

Magazine screwdriver with a fool-proof gear-shift

A Giant Condenser

SO far as is known the single-unit mica condenser illustrated herewith is the largest in the world. It has just been completed by the manufacturer for use in one of the Government radio stations. It has a capacity of .0025 microfarad at 90,000 volts with 1855 kva. It is of the oil immersion type. The top insulator is of porcelain and the high tension terminal projects from it.

Condensers of this general type have been made by this New York concern for some time but the one shown is the first of its size to be manufactured. Similar condensers will shortly be in extensive use in connection with power factor correction for lightning protection and for other uses. Recent reports are that the installation of this condenser has increased the station efficiency by 10 per cent.

By way of comparison the gentleman standing at the condenser holds in his hand one of the same company's condensers as ordinarily employed in radio receiving. As may well be imagined the enormous difference in size introduces manufacturing problems that are by no means easy to meet.

Can-Openers of the Month

TRADITION has the lock nut and the garment snap as constituting the most fruitful field for invention when measured in mere numbers of patents. We have expressed at one time or another a suspicion that the monkey wrench and the combination utility tool were close competitors and it just dawns upon us that another implement in which the scope afforded to ingenuity practically without limit is the can opener. We illustrate the remark with two examples.

One of these at the expense of a little more space than is usually taken up by the can opener does what we have not seen done before—it actually holds the can while it opens it. This in a way supersedes the safety can-opener, because

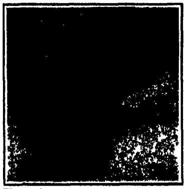
The non-skid can-opener

the only reason why the average housewife cuts herself on the can is that the latter slips in her hand. In addition this opener cuts the whole top off clean leaving a smoothly turned edge. A left hand turn of the crank opens the machine for insertion of a can and a right hand turn performs the decapitation. The apparatus occupies space—but no more than the less-used meat chopper.

For cans of fluid every user knows that actually removing the top is unnecessary; that two holes punched in the top, one for the entrance of air and one for the exit of the contents, are quite sufficient. With special reference to canned milk we are now offered a simple device for punching the two holes at the most advantageous spacing.

An Outside Micrometer with No Moving Parts

THE latest micrometer instrument is of a steel tape design. It measures diameters from 2¾ to 5 inches by thousandths of an inch. It does the work of a micrometer caliper, though instead of reading decimals, it gives direct reading in thousands and fractions thereof. For instance if an article should measure 3.3175 by the micrometer caliper this instrument will give a direct reading of 3 5/16 plus five thousandths. This is mighty handy to the mechanic who is not well versed in decimals. The graduations are quite legible as they are about one-eighth of an inch apart. This is possible, because while they represent diameter measurements they stand on the circumference and hence are more than three times as far apart as the corresponding marks on an ordinary straight rule would be. The tape is wrapped tightly around the object with the two scales abutting each other. The one piece construction eliminates faulty adjustments. Being so compact it may be easily carried in the kit or pocket, and requires no adjustment in use.



The easiest way to get into a milk can

Plating with Cobalt

PROBABLY the newest development in electroplating is the deposition of cobalt. Recently announcement was made of the discovery of a new process for electroplating with chromium, but the cobalt development is still more recent. A few years ago some Canadian research workers in the Canadian Department for Mines created considerable interest by putting forward a proposal to use cobalt as a metal for electroplating in the place of nickel. The results of these researches showed that cobalt could be deposited on brass, iron, steel, copper, tin, German silver, lead and Britannia metal and that the deposits were firm, adherent, hard and uniform and could be readily polished to a satisfactorily finished surface. The cobalt deposited was harder than the nickel and the speed of deposition considerably greater. It was also claimed that its resistance to corrosion was definitely superior to that of nickel, and that the deposits stood satisfactorily all the usual bending, hammering and burnishing tests. The actual weight of cobalt required for a good coating was stated to be about a quarter that of nickel. It is possible to electroplate with cobalt quite satisfactorily and very rapidly but it is unlikely that cobalt will ever attain the industrial importance of nickel.

Better Picture Frames Through a New Vise

THE heavy old-fashioned picture frames may have passed away, but there are thousands of smaller frames being sold to the hundred of the old style frames. In art shops the making of picture frames is a large part of the business and the frames going through are ranging in size from those to carry post cards and smaller mottoes to some that are several feet in each dimension, and the molding used varies from a fraction of an inch in thickness to several inches. The volume of the business requires maximum speed, especially since

New and ingenious idea in the micrometer field

the prices do not justify high costs. In nailing the smaller moldings there is more danger of ruining the job or putting the corners together in unsatisfactory way than there is in making the frames of the larger molding.

During the war one art dealer had to use so many green employees that he invented a special vise that enabled a green girl with little practice in driving a nail to turn out in a half day more work than several experienced men would complete in a day and do the work more satisfactorily. He realized that the danger point was in driving the nails for the corners so his vise was arranged to handle that part of the work.

A set screw in the standard brings the under gripper of the vise to a position where by stepping on the pedal the frame is held between this gripper and the two rests with the angle of the frame open for nailing operations. Some of the advantages of the vise as proved by its inventor's experience are that the frame is held rigid and the operator has both hands free, this removing the necessity for nail setting. Nor are there holes to drill. No operations for the hands are necessary, the feet performing the operations that grab the frame. Cross-nailing, one of the "ticklish" phases of frame-making, is easily done without turning the frame. Small frames as well as large ones and small molding as well as molding two inches wide can be handled. It has helped this dealer to put frames on the market to meet a popular price demand.

The newest and best way in making picture frames

Small electric drill of extreme sensitivity

Electric Drills and Utility Tools

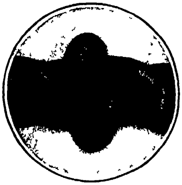
THE range of electric drilling and general utility tools is amply demonstrated by the two units which are illustrated at the top and bottom of this column. At the top is a machine designed to fill the demand for a bench drill that could be depended upon for absolute accuracy and extreme sensitiveness. At the same time it is adaptable enough to be used on many kinds of work. The motor is dynamically balanced, and runs equally on direct or alternating current. A ball thrust bearing takes up all end play, and wicked grease cups insure positive lubrication. Perfect concentricity in the drill is had by carefully grinding the gripping joints of the chuck jaws. Quick-acting locking devices make the raising and lowering of the motor or work-table a simple operation. The work-table is rack-and-pinion operated, and easily controlled by the operator's hand. A depth gage regulated by a thumb-screw prevents the drill's going too deep. The balance of the table and its gearing is such as to bring drill breakage to a minimum with the smallest and most delicate drills. "Perfect control, ease of operation, and unusual adaptability" are the claims made for this machine, apparently with good reason.

The general utility tool illustrated below is produced by the same manufacturers. The motor speed is reduced through a worm-and-gear drive that assures ample torque. Particular attention is called to the hand piece, fitted with a double-row ball bearing that takes up all thrust and radial load. The chuck will hold tools from one-eighth inch down to No. 80 drill. Its speed is from 500 to 2000 revolutions per minute, controlled by a five-speed rheostat. The chuck guard, which permits gripping the hand-piece close to the work, can be removed with a single turn. All together, this tool seems a fair match for its brother in efficiency and all around adaptability.

The electric jack-of-all-tools

Better Tire Chains for Next Winter

AMONG the things that every automobilist knows are the comparatively short life of the cross links of anti-skid chains, and the unsatisfactory action of the clips that hold the side chains together. Especially if one is obliged to drive over alternating stretches of country road and concrete, the former being in such shape as to demand chains while the latter is substantially clear, one finds that the chains do not stand the gaff. Replacable cross links, while conserving the undamaged side chains, are really a begging of the question. And who has not had to stop in dirty weather to unwind a chain from the axle, about which it has been permitted to fall and entwine itself by the opening of one of the clips?



New style of cross link that gives longer life to tire chains

We illustrate herewith the latest devices of the chain makers to overcome these drawbacks. The new style of link offers a far greater amount of metal to the road at a given instant, and hence should last far longer. And the new clip not alone closes and locks more positively than its predecessor, it also makes it easier to bring together within clipping distance the two ends of a chain that is just a finger's breadth too short to go around the tire easily. This latter advantage, however, is a collateral one beside the positive locking feature, it will be plain that the clip actually hooks around itself, instead of depending upon surface friction or spring tension to hold it closed.

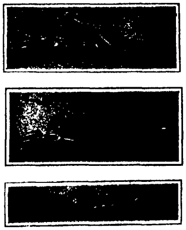
Motion of a Sphere in a Rotating Liquid

A SPHERE of uniform density is supposed to be suspended in a uniformly rotating liquid of the same density. An initial relative motion of the sphere parallel to the axis of rotation is set up by an instantaneous impulse sufficient only to effect a small disturbance in the motion of the system, small motion being defined to be such that the squares and products of velocity and vorticity components may be neglected in the expressions for acceleration. The initial disturbed motion of the liquid will then be irrotational, since the effects of rotation take time to develop. Now the pressure intensity of the liquid consists of two parts, one depending only on the distance from the axis, and the other on the disturbed motion. When the disturbance causes the sphere to move parallel to the axis of rotation, the disturbed motion of the liquid will continue symmetrical about a line through the center of the sphere parallel to this axis, and the motion pressure of the liquid will also be symmetrical about this line. The resultant effect on the sphere will, therefore, be to produce an acceleration parallel to the axis of rotation, causing the sphere to continue its motion parallel to the axis of rotation, and its line of relative motion may be called the axis of the sphere.

It is found most convenient to assume the existence of this particular type of motion, and then to show that all the conditions can be satisfied by making it a particular function of the time, a perfectly definite mathematical problem, the solution of which gives the following results. The sphere oscillates about a point on its axis, the distance of which from the initial position of the center of the sphere is proportional to the velocity of projection, the amplitude of oscillations rapidly approaches zero, but the period approaches a constant value half that of the undisturbed rotation of the liquid. A general expression is obtained for the velocity, at any point, reducing to simple expressions in particular cases, which are examined in the paper. It appears, however, that the gradients of the velocity of the liquid over the equatorial plane of the sphere and of the transverse velocity along a meridian of the sphere ultimately increase without limit, a stage being reached after which vorticity components cannot be considered small, so that the solution will represent the true state of the liquid only for a limited time. The question of the ultimate physical state thus remains unanswered. J. Proudman has shown that a small steady disturbance is impossible, but G. I. Taylor obtained a solution of the general equations of steady symmetrical motion about a sphere, which does not satisfy the equations of small motion.—*Science Abstracts, 626, 1923, based on paper by S. F. Grace, Proceedings of the Royal Society, 102, pages 89-111*

Research on Edible Gelatin

ANNOUNCEMENT is made of the establishment of a Fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh,

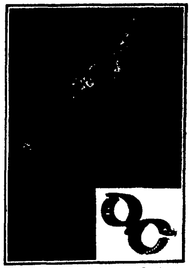


Partly open, open and closed positions of the new chain clip that hooks positively instead of depending upon friction to keep it closed

for the purpose of ascertaining the real food value of edible gelatin in its manifold applications in the American dietary.

The founding of this Fellowship is the outgrowth of the desire of the gelatin manufacturers to uphold high standards in the manufacture of this food and to have available for their own use and for the trade data of scientific and technical nature respecting its advantageous use in the food industries.

In addition to experimental investigations, a correlation of all available facts regarding edible gelatin will be made, to be held at the disposal of all users and prospective users of the product. The present incumbent of the Industrial Fellowship is Dr. Thomas B. Downey, who will be glad to furnish any available information to those interested in the uses of edible gelatin.



The newest substitute for the hose reel

Exit the Hose-Reel

SOMETHING far simpler than the hose reel is offered the amateur gardener in the clip illustrated herewith. For moderate lengths of hose, much less space is occupied by a hose looped on itself once like a hoop fastened by the clip, and hung on a peg, than by one reeled up in the old fashioned manner.

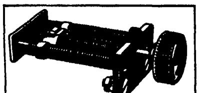
Periodic Annual Variation in Pendulum Rate

COMPTES RENDUS, 175, pages 748-750, gives an account by R. Goudey of observations on a pendulum in the Besancon Observatory. This pendulum is in a ground floor room enclosed in a double glass case, so that the temperature varies slowly, but variations of atmospheric pressure are felt. It appears that each year this pendulum runs slow beginning about April 11, that from that date until September 11 there is a series of rather indefinite fluctuations, and that, subsequently, the pendulum moves at its mean rate until near the end of the year. The movements have been established by curves plotted for twelve different years; they cannot be explained by changes either in temperature or in pressure, or as the result of chance. Whether they are a peculiarity of this pendulum, or may be looked for in other instruments, does not appear.

A More Sensitive Radio Rheostat

RECENTLY there was placed on the market a radio rheostat with greater automatic features than have been offered heretofore. It gives the most precise control of filament current, inasmuch as the range which is covered by three-quarters of a turn to three complete turns on most instruments, is here spread out over 40 full turns of the knob. This does away with all necessity for hair's breadth adjustments.

Two parallel mounted wire-wound, fire-proof resistance tubes are connected in series by a micrometer-operated slider, the length of wire in the circuit depending upon the location of this slider. At "full on" position the device possesses practically zero resistance, and



Radio resistance member that requires no minute adjustments

it gives a uniform change with each full turn of the knob right up to its maximum. One full turn of this knob, it is claimed, yields a finer adjustment than the hair's breadth change on the more familiar rheostats.

A Flexible Ruler for Drawing Curves

ONE of the most ingenious drawing instruments that we have seen is shown to us by a German inventor, Walter Arndt of Dresden. This, by direct translation of its formidable German name, is seen to be a flexible curve ruler with changeable curves. It is, in all details of appearance, just like the stencils used by draftsmen all over the world for drawing curves. But it is made of a pliable and elastic material, so that within due limits it can be bent further around, or straightened further out, to give a series of related curves of varying degrees of flatness or sharpness. The degree to which the shape may be changed without causing the instrument to buckle up from the flat surface of the drawing is indeed surprising—Herr Arndt has sent us samples and we have verified this for ourselves. Yet it is stiff enough to hold its shape against the pencil pressure.

Ohm's Law at High Field Strengths

IT is customary to regard the motion of electrolytic ions as very slow, and the author investigates the problem as to whether the velocity will grow proportionately to the force for much stronger fields than those usually employed, i. e., does Ohm's law still hold valid. Lenard, from kinetic considerations, concludes that for field strengths of 10^6 volt/cm. deviations occur for the H ion, which quickly grow according to the square of the field strength. The author is of the opinion that our meager knowledge of liquid constitution demands an experimental proof for Lenard's conclusions; hence the present investigation. The difficulties attending the measurement of the resistance in such high fields (100,000-volt/cm.) are considered, and the method of surmounting them given in detail. The paper contains several diagrams of apparatus and data curves. The solutions employed for the measurements were of sodium chloride, sulfuric acid, and sodium chloride containing 47 per cent of cane-sugar with which to increase the internal friction of the solvent. From the results obtained the author concludes that up to field strengths of about 500,000-volt/cm. Ohm's law remains valid only up to 1 per cent, and he claims to have established a qualitative confirmation of the Lenard theory. —*Science Abstracts based on paper of M. Wien, Physikalische Zeitung 23.*

The Electrified Wash-Day

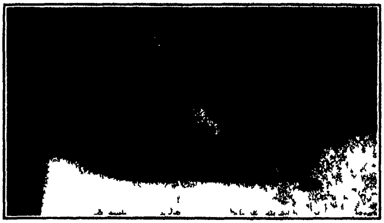
MONDAY and Tuesday will lose much of their terror for the housewife through the more general adoption of washing, drying and ironing machinery; and a typical example of what inventors are doing in this field is shown on this page. This assembly is designed to operate on the continuous-run principle. One garment at a time passes through it. While the second article is in the drying cabinet the housewife has time to put the third one in the washer and run the first through the ironer, and so on to the end of the family wash. The machine is more largely manually directed than some of the better known washers, but it calls at no stage for the use of the operator's strength.

The dryer is so constructed that the air is heated immediately before intake by a gas heater and radiator, or electricity may be substituted. The dry heated air is forced along the bottom, rising through the clothes and near the left end to the top, whence it is again forced downward through the remaining clothes by the hot air agitator, operated by its own motor from a light socket. This combination gives a powerful, continuous and uniformly distributed circulation of clean, hot, dry air.

This dryer overcomes one objection that many women have to clothes dryers; it does not "cook" the clothes, but dries them quickly and evenly and bleaches them properly. In addition they are protected from smoke and dust. The drier is again useful in disinfecting clothing, blankets, furs, and the like, ridding them of moth, etc. The gas heater in the dryer may also be used for heating hot water.

The ironer, electrically operated, is fitted out with two rolls, rather than one, which permits much better adjustment of the rolls and the work in relation to the heat. It carries a stationary foot-table, giving the operator a place to work on when straightening out, taking back, feeding in, or changing anything that is about to enter the machine. The receiving tray is of galvanized sheet steel, heavily enamelled, and is entirely sanitary. All the gears are enclosed. The washer is operated electrically and is similar to those on the market. Either of the three units may be separately operated.

A complete electrically operated wash-day outfit that washes, dries and irons the clothes in a continuous run, or that can be used for any one or two of these operations alone



This drawing stencil of hard but flexible material makes it possible for the draftsman to draw numerous curves of different radii with the one instrument

Ruler, protractor, T-square and compass are combined in one tool by this ingenious device

The juggernaut that converts a rough right-of-way into shape for paving, at a single operation, the claws at the front breaking up the ground and the blades at the rear making a finished job of the grading

Four Draftsman's Tools in One

THE draftsman in the third photograph on this page is using a single instrument that takes the place of four. The circular part under his hand is obviously a protractor. The straight part between his hands is with equal clearness a ruler. The possibility of using the instrument as a T-square is self-evident. And the user is shown getting out of it the service ordinarily rendered by the compass.

This is effected by a simple device. The draftsman's left hand is shown grasping a little pivot point which can be securely attached in the angle of the T and in such fashion that the point itself, piercing the board on the under side, is exactly in line with the scale along that side of the ruler. An adjustable slide moves up and down upon the ruler, carrying a little ear that projects across the ruler's edge, and that is provided with a hole for the pencil point. Thrust through this, the pencil lines up along the ruler edge with the pivot point. In this way an accurate radius may be struck, and the swinging of the arc follows easily. Incidentally, the zero point on the protractor is also in line with the pivot point and the pencil point, enabling the user to pivot the instrument and lay out angles with extreme ease and speed.

A Giant Plane for Subgrading Our Roads

THE business-like fashion in which the road-maker of today goes about preparing the site on which he is to lay his pavement is put before the eye in graphic style by a glance at the sub-grader illustrated at the bottom of the page. This machine is such a big, heavy affair and takes such a huge bite that it has to run on a temporary rail. The rail is in sections, which are taken up behind the machine and put down immediately in front of it, so that the requirement of smooth trackage does not at all delay the game.

In front are seen the scarifying teeth which start the job of breaking up the subgrade. Behind them, less plainly seen, are the big blades that finish it. After the subgrader has passed, the subgrade is left planed off to the exact depth desired for the laying of the road slab. The blades can be very finely adjusted to take exactly the depth of cut desired. The machine will cut either a flat or a crowned subgrade, and can also be set for the [illegible] Illinois [illegible] of road [illegible] thicker [illegible] the [illegible] ditch [illegible] machine to [illegible] or [illegible] thicker [illegible]

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Electricity to Be Generated From Dry Gas

AFTER the gasoline is recovered from casing-head gas, there remains a product, known as dry gas. Recently the Government authorized one of the large operating companies of the mid-West to utilize the dry gas for the generation of electricity, which is then used in running the well pumps. The use of dry gas for this purpose is intended to reduce the cost of well operation as well as increase the output of the well.

New Paper Stock: Cypress Pine

THE West Australian Forest Products Laboratory has announced that the wood of the cypress pine, a tree which is indigenous to Queensland, is suited for the manufacturing of paper. The paper is brown in color and is claimed to be superior to that obtained from the hoop pine and silky oak, two recent developments brought forward by the same laboratory. In fact the cypress pine paper is said to be lighter, thicker and stronger than imported Kraft paper. It has also been found that the silky elm or brown oak of the coastal forest is almost equal in value to the cypress pine.

Preservation of Fish Nets

ACCORDING to the United States Bureau of Fisheries the efficacious methods of preserving fish nets are tanning, tarring and creosoting. In the tanning method the nets are left soft and pliable. After the nets have been dipped into the tan liquor it is well to give them a treatment with bichromate of potash, which increases the preservative powers of the tanning materials, such as quercitron, catachu, gambier, etc. Hemp threads are afforded protection in this way as well as cotton threads but not to so high a degree. Tarring the nets is the principal method used in the United States. It consists simply of passing the nets through hot tar, removing the excess tar and then partially drying. This is a very effective method as the coal tar used is an antidote against putrefaction. Creosote oil is also used for preserving nets. It is a good preservative and causes little shrinkage. The principal objection to its use is that it washes out too readily, or evaporates from the net.

Gasoline From Coal

ACCORDING to experiments that have been made in Mannheim, Germany, the Germans have succeeded in making gasoline from coal. A report from the American Consular Service indicates that a plant has been established for making about 60 tons of gasoline a day from coal. The conversion of the coal into gasoline is accomplished by "hydrogenating" the coal, whereby its chemical nature is changed. About 90 per cent of the coal is thus converted into a liquid, which is similar to fuel oil in its chemistry and fuel value.

Belt Dressing From Old Rubber

OLD rubber, worn-out inner tubes and the like may be used in a composition employed as a belt dressing and [illegible]. The rubber is first cut up [illegible] pieces and then heated in an [illegible] to the desired temperature. [illegible] heat reduces the rubber to [illegible] condition. Old rubber, which [illegible] subjected to more or less oxidation due to exposure to air, is used preferably, as it produces a superior product. Old rubber which contains such substances as zinc oxide, sulfate of barium, lampblack, etc., gives good results.

A thick, heavy liquid substance is produced by the fusing process, which is no longer rubber but which is of very heavy consistency, highly adhesive, of a waterproofing nature and capable of adhering strongly to surfaces and of forming a frictional coating on them.

New Protective Agent for Animal Fibers

ANIMAL fibers, such as wool, silk and substances such as leather and skins are protected against the action of alkalies in their finishing and treatment processes by means of a product, known as Protektol, which is prepared from sulfite cellulose waste liquors. This represents just another way in which these liquors can be put to good use. For further details the reader is referred to the *Deutsches Woolengewerbe*, Vol 54, page 1551.

Making Artificial Egg Substance

A SUBSTITUTE for white of egg and yellow of egg is made from fish roe, according to a German process, which is patented in German Patent No 342,308. The roe is first extracted with fat and lecithin solvents, such as alcohol and ether, and then after the solvents have been removed by evaporation, the substances remaining are treated with a hydrating agent until they take on the odor of egg yellow. This mass is then mixed with protein substances or the protein residues obtained in the extraction of the fish roe. Palladium, precipitated on very finely pulverized infusorial earth, is used as a catalyst in the hydration. About 40 kilograms of egg substitute can be obtained from 100 kilograms of codfish roe.

Durable Stain for Woodwork

A NEW German patent, which describes a process for making a durable stain for woodwork is as follows: A solution of one kilogram of commercial deep brown stain (Cassel brown, consisting chiefly of alkali humates) in 30 to 40 parts of water is filtered and heated to boiling, and about five liters of a two per cent solution of ferric chloride are stirred in, in a thin stream, until the mixture will filter easily and the filtrate shows an excess of iron. After decanting as much of the liquor as possible the remainder is passed through a bag filter, and the solid residue is dried on porous clay plates, or in a vacuum, until the paste, mixed with a little ammonia, forms a stain ready for use. This stain soaks well into the wood, and on evaporation of the ammonia becomes insoluble through the decomposition of the complex ferro-ammonium compound of humic acid.

Metal Linings by the Spray Process

THE spraying of metals on surfaces in order to produce metallic coverings is not a new process, but to the present time it has not given the most successful results. The coatings that have been obtained hitherto have been of a porous character, which is a decidedly undesirable property in resistant linings for chemical apparatus. It is now claimed by the German company, known as Metallisator A. G of Altona that thoroughly satisfactory tin, lead, aluminum and copper linings can be produced on iron by subjecting the sprayed metal coat to a finishing process, which may be either mechanical or chemical or both. The lining may be rendered more coherent by hammering. The pores may also be filled up with some chemically resistant material, for example, in the case of lead lining with lead sulfate obtained by treating the lining with sulfuric acid. The great advantage of these sprayed linings over the usual laid-on ones lies in their close contact with the underlying material, which is an important factor in apparatus with walls through which heat is to be transferred.—*Chemiker Zeitung*, Jan. 11, 1923.

New Oil Seed From Gold Coast

THE nut known as Kisidwe can be used to good advantage as an oil seed. The oil content is about 44.2 per cent of the entire weight of the nut. The fat could probably be used as food and in the manufacture of soap. The removal of the shell, which is thin and which forms only about 38 per cent of the weight of the nut, should not present any difficulty. The residual mass, after the extraction of the oil, possesses a bitter taste due to the tannin contained in it, and hence is unsuitable for cattle food.—*Bulletin Imperial Institute*, XX, No. 4, 1922.

Building Stone From Castor Bean Refuse

IN England a building stone for interior purposes is made from the refuse that is recovered from the extraction of castor oil from the castor bean.

Asphalt Vapors a Moth Killer

TESTS have been made in Germany to determine the effectiveness of asphalt fumes as a moth killer. The asphalt is vaporized by being heated in an enameled pot and the vapors are allowed to enter a well-closed room, where they exert their destructive action on the moths.

Sulfur Dioxide from Sulfates

WHEN alkaline earth sulfates, such as sulfate of magnesia, lime and strontium are mixed with iron and then heated to the proper temperature, the sulfate is decomposed by the iron with the evolution of sulfur dioxide gas. This reaction is generally carried out with the aid of carbon, and in this case, where iron supplants carbon, the reaction can be effected at a considerably lower temperature and also with a better yield of sulfur dioxide gas. This process is described in detail in the German publication entitled *Zeitschrift fuer angewandte Chemie*, volume 125, pages 337-348.

Uses of Zinc Dust

AN interesting list of the uses of zinc dust in the powdered state is quoted in a recent issue of *Chemical and Metallurgical Engineering*, April 9, 1923. The chief properties for which zinc dust is used may be summarized as follows (a) reducing properties, as in the dye industry, for reducing nitro compounds to organic amines and in preparing sodium hydrosulfite for the reduction of vat colors, (b) the property of precipitating metals from their solutions, in purifying zinc sulfate solutions for electrolysis or for the manufacture of lithopone, (c) the property of combining with dry oxygen only at a high temperature and of giving with moist air a basic carbonate or with sea air an oxychloride which protects the metal from further oxidation. These properties have led to its application in painting iron objects, sherardizing (that is, immersing iron objects in zinc dust at a temperature of 300 degrees Centigrade), galvanizing cast iron and metallization (that is, deposition by projection of a layer of zinc on the surface of a metal). Zinc dust is usually obtained as a by-product from zinc smelters, but it is also made by blowing gas against a stream of liquid zinc or by grinding. Such dusts contain varying amounts of impurities, some of which are undesirable for certain uses. Microscopic examination has shown that the grains of zinc dust consist of metallic globules coated with crystals of zinc oxide which prevent the globules from uniting.

The Use of Aluminum Vessels

ACCORDING to an article which has been published in the *Zeitschrift fuer das gesamte Kohlensaure Industrie*, volume 51, number 20, aluminum vessels are particularly well suited for the manufacture of light colored lacquers and varnishes. The color of the product is not affected when the manufacture is carried out in these vessels. On the other hand, aluminum is very sensitive to organic acids. When aluminum vessels are used for cooking or distilling in the factory and for cooking food in the household, the interior of the pots and pans and factory apparatus become coated with substances which cannot be removed by the ordinary methods. Hence the following composition was devised and was found to be very effective in removing these deposits from the interior of aluminum utensils. A solution is prepared containing 90 parts by weight of technically pure crystalline sulfate of alumina and 10 parts of soda crystals. The aluminum vessel is filled with water until the dark colored spots and places are covered. About one to three teaspoons of the above saline mixture may be added to the water in accordance with the size of the vessel. After the water has been brought to the boiling point, it is found that the deposit on the aluminum has been entirely removed.

Bio-Chemical Engineering

GIVING credit to C P Steinmetz for the idea, a recent issue of *Chemical and Metallurgical Engineering* asks editorially, and answers in the affirmative, the question whether the above words define a new profession of importance. It is pointed out that biology is coming to play more and more a role in our chemical problems. The expansion of the sugar industry through attention to the intensive cultivation of the plant, and the suggestion that the biologist, through the intensive production and the economic utilization of alcohols and other forms of plant energy, may solve the fuel problem, are cited as evidence of the place that bio-chemistry may come to fill in the general engineering structure.

The Heavens in August, 1923

Measuring the Minute Heat Radiations Received by the Earth from the Stars

By Professor Henry Norris Russell, Ph.D.

THE cold moonlight is a commonplace of literature and with good reason. Though the rays of the sun warm us—and cheer or exhaust us according to the season—those of the moon produce not the least effect upon our temperature sense. This is not, of course, because no heat radiation accompanies moonlight, but for the simple reason that the nerves of our eyes are exquisitely sensitive to light while those of our skin are but crudely so to heat. No artificial appliance can begin to compete with the eye in sensitiveness to light—unless indeed we use something like the photographic plate, which adds up the cumulative action of hours. But it is very easy to make heat detecting instruments incomparably more sensitive than our cutaneous nerves. With such devices the heat not merely of the moon but of the stars can be detected and measured as Coblentz has done at the Lick and Lowell Observatories, and as Pettit and Nicholson have done more recently and in like manner at Mount Wilson.

The heat measuring device is very simple both in appearance and in theory. Two tiny wires of different metals meet in a little disk blackened to absorb any radiation which falls on it. If this junction is heated while the rest of the circuit of which it forms a part is unaffected, an electric current will be set up which can be registered by a sensitive galvanometer. Various metals differ in thermo-electric power, and by a suitable choice, such as making one wire of bismuth and the other of a bismuth tin alloy, the current can be increased. If the wire of alloy is soldered to a bismuth wire at each end and first one junction and then the other is exposed to the source of heat, the currents will flow in opposite directions and the observed effects will be doubled.

Theoretically, then, things are very simple, but to realize high sensitivity in practice is anything but easy. Since the heat of a star, even though concentrated by the greatest telescope, is very feeble, the receiving disk and wires must be made as small and light as possible. In the apparatus used by Pettit and Nicholson the disk is about 1/50 of an inch in diameter and 1/3000 of an inch thick, while the wires, or rather strips of metal, which lead to it are 1/250 of an inch wide and 1/3000 of an inch thick. To assemble and mount so tiny and fragile an affair demands great manipulative skill.

The slightest breath of air blowing past the junctions would cool them more than a star could heat them. So the whole apparatus is put in a glass tube exhausted to a very high vacuum. The window on this tube through which the starlight enters must not be made of glass but of fluorite or rock salt, which, unlike the ordinary type of glass, are transparent to the long invisible rays as well as to the short ones that we call light.

How the Observations Are Made

All this care would be of no avail were not the electrical instruments equally sensitive. Here, fortunately, the astronomer has the advantage that sensitive galvanometers are used in many lines of scientific work, and can be obtained commercially. The deflections of the tiny suspended magnet are read as usual by reflecting light from a mirror that turns with it. If the mirror is of very good optical figure the scale can be placed as much as twenty feet away and good results still obtained. Such an instrument will give a deflection of two millimeters—very easily observable—for a current of a millionth part of a milliampere. This galvanometer is not set up in the dome but far below in the basement in a room protected from changes of temperature. The wires connecting it with the receiver at the telescope, which must be about a hundred feet long, must themselves be very carefully installed and shielded.

When all precautions have been taken and the apparatus is in good order—as the writer saw it a few days ago—it works like a charm. The hundred inch telescope is set on the star and the observer looking through another window at the back of the vacuum cell, sets it first upon one and then upon the other of the junctions. Meanwhile a second observer in the basement connected with the first by telephone records the readings of the galvanometer.

In practice, this is done photographically on a plate moved slowly downward while the spot of light swings back and forth across it. It is extraordinary to watch it shift regularly back and forward as the star is set on one or other of the two junctions and to realize that the energy which moves the image actually comes from the star. For in this case there is no terrestrial source of electromotive force set into action by a relay; the star's own heat supplies the power. Calculation shows that less than one fifty thousandth part of the heat received from the star is turned into electrical energy, and this low efficiency is almost unavoidable; for the rise in temperature of the heated junction is little over a tenth of a degree even for the brightest stars and for the average star is much less even than this.

The heat measuring device, in its present perfection, adds a new and very important weapon to the armory of the astrophysicist, and we may expect to hear much of its results in the near future. To speak of but one thing now, it is found that stars of different spectral types, that is, of different temperatures, give very different amounts of heat in proportion to their light. For the same brightness, as observed by the eye, the hottest stars send us the least total heat and the coolest ones the most. This sounds very extraordinary until we turn the thing around and say that for equal amounts of total heat, the hottest stars give us the most light—when we recognize at once the factor of luminous efficiency familiar to everyone who understands why a tungsten lamp which runs at a higher temperature than its carbon predecessor, saves half our lighting bills.

What It All Means to the Astronomer

This bids fair to give us the best means at our disposal of estimating the temperatures of the cooler stars. For example Alpha Herculis, a red star of what is called Class M, gives only about one-fifth as much light, in proportion to its heat, as most stars of its sort, and hardly one-fiftieth as much as a white star like Vega. This indicates that its surface temperature must be much lower—perhaps 2400 degrees as against 3000 degrees for an ordinary red star like Antares.

This was shown several years ago by Coblentz. The Mount Wilson observers have recently found much more remarkable cases among the long period variables. Stars of this sort, near maximum, are comparable with ordinary red stars. But near minimum, when their light may drop to less than one per cent of the maximum brightness, their heat is still perhaps one-fifth of the maximum amount. Stars of this sort, invisible to the naked eye, may send us more heat than Vega. In certain instances the ratio of light and heat is something like one ten thousandth part of the value for a white star. This indicates relatively very low temperatures, probably from 1200 to 1500 degrees Centigrade. We may look upon these variable stars, then, as bodies which periodically and for reasons still unknown cool down from the ordinary stellar temperatures—which begin where laboratory temperatures leave off—to temperatures such as are found in every foundry. At these lower temperatures practically all the radiation is in the long invisible waves, the visible light forms but a beggarly fraction of the whole.

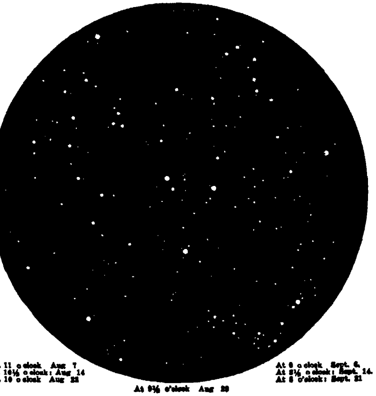
Further work with this new and powerful instrument of research will tell us much regarding the temperature conditions of the stars and of the moon and planets too.

The Heavens

Turning to our usual star-gazing, we find Cygnus right overhead—the swan being fairly easy to imagine flying north eastward down the Milky Way, with his outstretched wings extending into the darker sky on each side. Along the galaxy to the northeast we find Cepheus, Cassiopeia and Perseus; to the southwest, Aquila, Ophiuchus, Sagittarius and Scorpio (setting). Lyra is west of the zenith, with Hercules, Corona and Bootes below. Draco and Ursa Minor are above Ursa Major, all being in the north northwest. Pegasus is well up in the east, with Andromeda on the left, while Aquarius and Capricornus are in the dull southeastern sky above Fomalhaut.

The Planets

Mercury is an evening star this month, but is south of the sun and is easily seen in our latitude. Even at the end of August, when he is furthest from the sun, he sets at 7:30 P. M. and is deep in the twilight. Venus is a morning star but very close to the sun, and practically invisible. Mars too is behind the sun, and in conjunction with him on the 8th, and is invisible. Jupiter is in quadrature east of the sun on the 3rd, and after that is an evening star, but is visible until after 9 P. M. even at the month's end. Saturn, being about 20 degrees further west, is an evening star too, setting rather more than an hour before Jupiter. Uranus is approaching opposition, and is observable late in the evening. Neptune is in conjunction with the sun, and is invisible. The moon is in her last quarter at 2 P. M. on the 4th, new at 6 A. M. on the 12th, in her first quarter at 1 A. M. on the 19th, and full at 5 A. M. on the 26th. She is nearest us on the 16th, and furthest away on the 3rd and again on the 31st. During the month she is in conjunction with Venus on the 11th, Mars and Neptune on the 12th, Mercury on the 13th, Saturn on the 16th, Jupiter on the 17th, and Uranus on the 27th. On the morning of the 26th a partial lunar eclipse occurs. For an observer on the moon, the first invasion of the sun by the earth's disk would come at 3:12 A. M. by our eastern standard time. But little will be noticed by the average terrestrial observer until 4:52 A. M., when the moon enters the shadow proper. She dips into it slightly, only one-sixth of the diameter being immersed at the maximum phase, at 5:40 A. M.; and she gets clear again at 6:27. This eclipse is without specially noteworthy features.



At 11 o'clock: Aug. 7
At 10½ o'clock: Aug. 14
At 10 o'clock: Aug. 22
At 9½ o'clock: Aug. 29
At 9 o'clock: Sept. 6
At 8½ o'clock: Sept. 14
At 8 o'clock: Sept. 21

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Stocking Crushed Stone

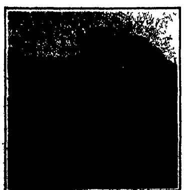
THE accompanying photographs show the method used in building high stock-piles of crushed stone for highway purposes on Illinois day-labor construction of pavement, under the supervision of the superintendent of construction, H. B. Jay Three-ton-capacity dumping body trucks were employed to haul the aggregate from the railroad, and by use of portable runways or tracks up which the trucks ran and dumped their loads, piles were easily built to a height of fifteen feet. The runway sections were designed to be of such a weight that two men could handle units in placing them in position and taking them up and moving to other set ups.

They were constructed in ten foot units of 4 x 4 stringers to which were nailed two-inch planks, making the tracks slightly wider than the tires. On top of the plank 4 x 4 guide rails, or curbs, were bolted, so that the trucks would stay on the runways. Each ten-foot unit was attached to the next one by means of three-quarter-inch iron hooks and eyes, and fastened together laterally by the same method All units were interchangeable.

Pile of crushed stone, as built by dumping motor truck

The Lubrication Problem

MORE and more attention is being given to correct lubrication of motor vehicles, for it is realized that no class of machinery requires more thorough lubrication. Various systems for supplying oil and solidified oil to various parts of the motor truck have been introduced of late. The most popular is in the form of a modified grease gun which is provided with a flexible hose and coupling for attachment to the special fittings where grease or solidified oil is to be delivered. A moment's work suffices to lubricate each part of the truck



Showing how tracks are laid up the stone pile to provide a runway for the road construction truck

New Cushion Tire for Trucks

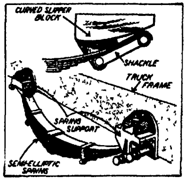
A PROMINENT tire company has announced the details of construction of its new "aircore" cushion tire for trucks. Produced in the full and double-cushioned types, the new tire is designed to provide displacement spaces located on both external and internal points to accommodate the flow of rubber when under pressure The company, pointing out that the solid tire tends to bulge out at points in front of and at the rear of the area in contact with the road, asserts that the external spaces, in the form of specially designed notches cut in the side walls and tread and the central hollow ring or core surrounding the base band of the tire, will take care of this "flowing" tendency The notches not only furnish displacement space but also a sure-footed traction in all weathers. In order to prevent the accumulation of stones or caked mud in the notches or vents, pebble ejectors, in the form of a step-like formation of rubber lugs, are provided in each notch.

The principal cushioning ability of the "aircore" tire, however, which permits deflection under load equal to that of normally inflated pneumatic tire, lies in the use of the central hollow ring which is in the shape of a continuous ring of a spear-shaped cross-sectional opening The advantage claimed for this type of cushioning is that the rubber displaced merely follows the easy curves of the core and side walls and allows the instantaneous recovery of the rubber to its normal shape after encountering obstructions in the road This latter feature is made possible by the short "nose," or distance between the outer end of this hollow space and the tread of the tire If the road shock were to be transmitted from the tread to the small circular opening near the base of the tire, a perceptible lag would be created which would render the action of the tire practically the same as that of a solid tire at high truck speed The "aircore" tire is intended by its makers for front wheel service on all trucks except the heaviest, and for rear wheel service on those trucks which require resiliency, high speed ability and economy of operation. It is made in sizes ranging from 34 x 4 to 40 x 8 and 36 x 10. The prices of the various sizes are considerably less than those of the same capacities of truck pneumatic tires.

Variable Length Springs

IN a recent British truck the semi elliptic rear springs have front and rear anchorages rendering them stiffer and augmenting the carrying capacity with increasing load, and vice versa The rear ends of the springs, themselves of almost normal design, are anchored to shackle plates as usual, though the plates project rearwardly at an angle of approximately 30 deg from the horizontal instead of being almost vertical with "no load," as shown in accompanying illustration Above each spring end the frame bracket has attached to its under neath surface an inverted curved slipper which, as the spring becomes deflected with increased load, forms an abutment for the end of the top leaf, progressively shortening the effective length of the spring

The shackle plates merely serve to locate the springs for the latter come into contact with the slipper almost immediately the first portion of the load is put aboard. The slipper is separate from the actual bracket, being of case-hard ened steel and renewable Grease cups are provided for the contact surfaces of slipper and spring as well as for the shackle pins. At the front ends the slippers also appear, though the shackles are absent The accompanying sketch shows this scheme, which, while of benefit with quarter and half loads of merchandise, especially fragile goods, shows to greatest advantage in connection with passenger transport vehicles which are apt to be lightly loaded at some times and heavily loaded at others.



Details of the design by which the springs are automatically lengthened as the load increases

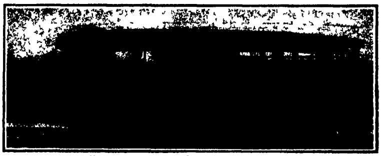
better traction secured by suspending the motor on coil springs direct over rear axle on one end of a sub-frame attached to the main frame

The sub-frame makes one-half of a complete truck as it has a swivel bolster built in the main frame so that it will turn at curves, thus eliminating flange wear and relieving side thrust. It is said that the car rides as well in the rear seats as in the center The car complete weighs but 10,400 pounds and makes eight miles per gallon of gasoline. The same principles may be used in construction of stages and omnibuses to run on the highways.

A New Type of Rail Car

THE accompanying photograph shows a gasoline driven rail car recently delivered to the Hetch-Hetchy Railroad at Groveland, California. This car has many new and distinct features. It seats thirty passengers and is built for either narrow or broad gauge railroads On the Hetch Hetchy Railroad it negotiates a five per cent grade, twelve miles long, with numerous 30 degree curves, at a speed of 27 miles per hour The Hetch-Hetchy Railroad have been operating gasoline motor cars for the past six years and this car is said to be more efficient than any of their previous equipment.

By placing the motor rearwardly of the driving wheels all revolving parts in front of rear axle are eliminated, thereby permitting a very low hung car, and all motor noises and smoke or gasoline odors are at the rear The passenger seating capacity has been increased without lengthening the wheel base and



Gasoline rail car with power plant at rear

A Large Tractor Trailer Outfit

WHAT is regarded as the largest pressed-steel drop-frame semi-trailer that has ever been built is 48 feet long over all 8 feet wide and 12½ feet high from the ground to the top, and is built to conform with the State of Michigan's trailer law, the maximum limit of which is 60 feet This trailer was designed to haul automobile chassis to South Bend, Indiana, and to bring back from South Bend automobile bodies. On each trip out of Detroit it carries five large chassis and on the return trip brings back 24 open automobile bodies painted and upholstered The largest freight-car can handle only from 16 to 18 bodies. The excessive freight rate on this class of commodity enables this trailer to handle 24 bodies for approximately one-half of what it would cost to transport them by rail. The bodies in this trailer stand up end-wise and are held in position by steel and wood frames so that they hang clear of the floor and do not rub or touch each other They are brought into the city of Detroit free from dust and scratches.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Possibilities of Subluxations

To the Editor of the SCIENTIFIC AMERICAN

Some time ago you had a vigorous editorial against the promiscuous licensing of chiropractors. I have no more patience with this cult than you have, but unless we confine ourselves scrupulously to the truth when we attack them, we strengthen them rather than weaken them Misstatements of the sort you made in the preliminary portions of this editorial are very common, and frequently are such as to throw discredit upon osteopathy

You infer that blindness and deafness cannot be cured by correcting subluxations, because 'the nerves to eye and ear never leave the skull.' The optic and auditory nerves to be sure are cranial, but some of the nerves affecting the eye and the ear come from the spine From a very complete discussion by Dr Lloyd Mills, F R., C S in the *California State Journal of Medicine* for January, 1921, I abstract the following items

The eye becomes softer after section of the cervical sympathetic Cervical tumors and fractures affect the eye Excision of the superior cervical ganglion in glaucoma has been followed by improvement in 40 per cent or more of cases. Numerous cases of pupillary irregularity may be cited in connection with enlarged cervical glands, mediastinal growths, aortic aneurism, pulmonary phthisis, pneumonia, thyroid tumors, etc., etc.

I have met a man blind for two years, whose sight was restored in a matter of hours by correction of cervical subluxation, by an osteopath I am personally acquainted with four osteopaths who have fully restored or greatly improved the sight of persons entirely blind, by cervical adjustment.

I should like to consider with you some possibilities in connection with the topmost segment of the spinal column, called the atlas, on which the head rests. A study of the atlas and its relations will show how easily they can become disturbed and some of the troubles that may come from such a disturbance.

The joint above the atlas, between it and the skull, allows the rocking motion of nodding the head, that below the atlas allows the head to turn from side to side. In reality, rather than just two joints, a large number of small joints make up the articulations of these three bones.

A sudden turn of the head, a blow, a bump, a fall, can produce sufficient trouble in one of these small joints to prevent free movement. Also there are many muscles, large and small, attached to the skull from neck and shoulders. A cold draft of air, a slight strain or injury, or other trouble may cause one of these to contract and hold one of the joints in a slightly unnatural position It is not so much that a bone goes beyond its normal range of movement, as that it becomes to some extent immobilized within that range Hence the failure of the X ray to locate some of the things for which the osteopath treats. Among the results may be headache, heart or stomach trouble, deafness, blindness, convulsions, insanity, imbecility

There are among the imitators of osteopathy those who pretend to be able to touch the spine, find which bone is misplaced, and tell exactly where the resulting disease may be found This is impossible These people also publish pictures of the spinal column, showing how a slip of one vertebra upon another may cause pressure upon a nerve, resulting in disease. This looks and sounds very convincing, but dissections of the human body do not bear out the theory that a vertebra can ordinarily press upon one of the nerves, and the picture of a nerve's being so pinched is an anatomical absurdity

Much of the blood supply of the brain comes through arteries that pass up with the vertebræ They are protected by the spinal column in the neck, actually passing up through little holes in the sides of the vertebræ When the atlas slips in relation to the skull, these arteries are interfered with and the medulla and brain stem do not get as much blood as they need. The eyes may suffer in consequence, or any of the other organs or functions mentioned above. The same lesion could cause a general nervous condition, because most of the nerves connecting the brain with the body must pass through this same brain-stem region Messages come in on nerves from all over the body, telling the brain what the conditions are, and the brain sends back messages telling the muscles what to do in consequence.

The incoming sensations could be interfered with in this region, so that the brain may get wrong messages and send back wrong orders to the muscles. To make matters worse, the nerves which carry the orders out to the muscles can also be interfered with here, and all sorts of jerkings and movements and even convulsions could result. All of this is in conformity with the theory of Dr A T Still, founder of osteopathy, who announced in 1874 that "The rule of the artery is absolute."

The internal carotid arteries bring the rest of the blood to the brain The caliber of the internal carotids is affected by fibers coming through the superior cervical ganglion of the sympathetic system, a bundle of nerves so close to the atlas that its blood supply, in turn, can be influenced by an atlas lesion

Neuralgia of the face may also be caused by such a lesion The chief nerve of sensation in the face arises from the brain and not from the spinal cord. Yet some of its fibers pass up to the brain from the upper part of the cord. It is easily seen how the blood supply to these fibers can be affected.

The vagus nerve is so called because it is such a vagrant or wanderer It passes down from the brain as far as to the heart and the stomach It emerges from the skull so close to the atlas that it can be affected, and far-reaching systemic disturbances brought about by the atlas lesion. These are only a few examples of the damage that may be done by a subluxation of one of the vertebræ. Any one of these things may happen Many of them may happen together There are 24 vertebræ and any one of them, as well as ribs, scapulæ, clavicles, and other bones, may suffer a subluxation with bad results. Most subluxations reduce themselves, either very soon, or when we relax in sleep. But some do not.

These osseous lesions, their effect and their correction, are studied and understood by osteopathic physicians. I cannot say as much for any other school of healing. I have outlined but the barest sketch of what actually does or may take place. To cover the subject would require a book.

The only reason I have for offering these remarks on chiropractic to you is that you are among those who have overstepped the subject and unintentionally cast doubt upon facts discovered and proved by Dr A T Still and his followers, who constitute a reputable and recognized profession

RAY G HULBURT, D.O.

Kirksville, Mo.

Gyroscopic Motion

To the Editor of the SCIENTIFIC AMERICAN:

The "classical" theory of gyroscopic motion propounded by the mathematicians and generally assumed to be correct involves the proposition that if all friction and air resistance were removed, the spinning wheel would describe indefinitely about the central support a series of festoons, the cusps of which would lie in a horizontal plane. This theory is clearly expounded in Barnard's "The Gyroscope" (1858) He says that if the described cycloid were a "material curve on which the axis of the gyroscope rested without friction and without rotation it would travel along this curve by the effect of gravity alone (the velocity of descent on the downward branch carrying it up the ascending one) with exactly the same velocity that the rotating disk does through the combined effects of gravity and rotation." This proposition is obviously untenable. The wheel in such case would not rise to the height from which it descended. No force would be applied by the stationary "material curve." The curve would, of course, deflect the motion of the descending wheel but in deflecting it it would check it (regardless of friction) The wheel would move the "material curve" in the opposite direction thereby imparting to it some of its energy Hence the wheel would not rise to the height from which it fell And if it did, why when it reached the top of a cusp would it go forward instead of backward?

Barnard then says that "rotary motion" of the wheel has "precisely" the same "effect" as the "material curve"—that it deflects "the body's path from vertical descent, finally directs it upward, and causes its velocity to be destroyed by the same force which generated it."

But "rotary motion" is a force and if such force causes an "effect" it is thereby to the extent of the "effect" generated, transformed; and if it be transformed to some extent, to such extent will its quantity in its original form be diminished. "Rotary motion" cannot produce an "effect" without becoming impaired. Hence the wheel will (in the absence of friction) finally cease to rotate Its force will be spent in the effects generated—precession and support of the wheel and axle against the opposed pull of gravity.

Barnard also says that "rotary motion has no power to impair the work of gravity through a given height in generating velocity but it does have the power to change the direction of that velocity" But certainly if it has the "power" to do this, and exerts such "power," to the extent that it does so by so much is its "power" reduced.

Because "rotary motion" has the "power" to "change the direction of" a "velocity" he infers that it can do so without impairment of its "power" But, of course, "rotary motion" can no more "change the direction" of a "velocity" without loss of its "power" than it can generate a "velocity" without such loss. It cannot have its cake after it has eaten it. According to the "classical" theory precession is an effect without a cause, *i. e.*, without a transformation of that which produces it.

The theory is plainly erroneous. Precession is occasioned by the force of gravity and caused by the force stored in the spinning wheel. Gravity tilts the wheel, thereby partitioning the force stored in it, part of which is then applied so as to generate rotation around a new axis. The application of such force to the wheel induces precession. It cannot revolve the fixed support around the wheel and so the wheel revolves around the support. Precession in turn results in the application of part of the spin-force against gravity and if it be sufficiently strong it will prevent the wheel from falling at once. Stopping precession shuts off the application of spin-force against gravity and the wheel drops. The removal of friction resulting in increased precession and the application of more spin-force against gravity prolongs the contest between the two forces but at length the spin force becomes too feeble to sustain the weight of the wheel and axle even under the stimulation of external force applied to increase precession. The "classical" theory is based on the assumption that the down-pull of gravity is "balanced" by an equal up-pull. But the force of gravity is practically inexhaustible, whereas the up-pull arising from the small amount of force stored in the wheel, is soon exhausted. Just as in time the force opposed to gravity when a weight is held in the hand will become exhausted and the weight will fall.

The force stored in the spinning wheel but originally stored in the muscles of the arm of him who spun it will in time be overcome by the greater force of gravity. A constant "balance" of the opposed forces is a mechanical impossibility. The gyroscope is not, as it has been called, a "mathematical device." It is a real thing and its movements conform to mechanical laws.

The proponents of the "classical" theory say that the humming of the wheel when the rotation is rapid is due to minute cycloids formed as described by Barnard, whereas in fact it is due to vibrations caused by friction. According to their theory the cycloids occur only when there is no friction. Friction would obliterate them. It is remarkable that this barbarous theory has persisted unexposed into this enlightened age.

L. A. REDMAN.

New York.

Mathematics and the Spirits

To the Editor of the SCIENTIFIC AMERICAN:

I am deeply interested in your articles "Our Psychic Investigation in Europe," by J Malcolm Bird, Associate Editor I have also read the statements made by Father C. M. de Heredia in various publications.

Let us now look and examine the question of spirit photography from another angle. Let us assume that the average death rate in a civilized community is 10 per thousand (which is low), and the average death rate in an uncivilized community is from 20 to 25 per thousand. We will take an average of 15 per thousand. The population of the world is stated to be sixteen hundred millions, making the total deaths per annum twenty-four millions, or twenty-four million spirits per annum. Now the age of man is variously estimated from six thousand years to sixty million years, the first estimate is not accepted by science. What is the age of the Neanderthal man? The Piltdown man? The Javan man? The answers are largely theoretical. Let us take the age of man from his first appearance and estimate the time one million years (also a low figure), multiply the above twenty-four millions by one million, we have a total of twenty-four quadrillion spirits! (a figure too stupendous for our imagination) since the birth of man, assuming that spirits are immortal.

Now questions arise: What is the position of spirits in space? Are they in our immediate vicinity? They must be or they could not be photographed. Do they occupy vacant space, or all space? When we move, do we push them aside? Do excrescences such as built by man, buildings, etc., displace them? Do fast-moving vehicles run over them (horrible thought), or push them aside? Do spirits have length, breadth and thickness, or just length and breadth, exhibiting only the face? Is the entire body spiritized?

Does each spirit have a separate space or are they a confused jumble? Now let us add the query, does man alone have a spirit? Or, has every living thing a spirit? If so, the total number of spirits since life began makes the question of spirit photography [illegible] ridiculous, as there would not be room on the face of the earth or in our atmosphere for such a vast number of spirits.

Will some believer in spirit photography answer these questions [illegible] in my mind [illegible] satisfied.

It is [illegible] and trust that your [illegible] in a [illegible]

[illegible]

[illegible], Mass.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—D. R. McCullough, R. D 58, Fallows, Calif. The particular object is to provide an airplane that has a maximum amount of lifting power as compared with the space occupied by the same. A further object is to provide planes that present a smooth forward edge, while the rear edge is toothed whereby an effect is obtained somewhat similar to that of the wings of a bird in flight, means being provided whereby the planes may be decreased in size. A further object is to provide means for creating an artificial partial vacuum whereby a lifting power will be exerted and ascent facilitated.

Pertaining to Apparel

FASTENER FOR REVERSIBLE GARMENTS.—J. J. Sommers, 48 Washington Terrace, Bridgeport, Conn. The general object of this invention is to provide a fastening for use with corsets and similar garments for converting them into reversible garments and thus to prolong the life of the garment. The fastener comprises loop and stud members, with means for forcing the studs to either side of the reversible garment to engage the loops.

Electrical Devices

FLASHLIGHT.—H. M. Koretzky, c/o Bright Star Battery Co., 310 Hudson St., New York, N. Y. The invention aims to provide a flashlight, the primary object of which is a construction by means of which an operator may manipulate the parts to absolutely preclude any danger of a circuit becoming accidentally closed, resulting in the exhausting of the battery, so that the operator may pack the flashlight among tools or metallic objects without fear A further object is the provision of means which virtually preclude any danger of the stem of the bulb becoming injured.

MARKING DEVICE.—Marie L. Gabcin, 238 W. 85th St., New York, N Y An object of the invention is to provide a device more particularly intended for use in connection with photography, and by means of which sub-titles and identification marks may be associated with a plate or film by directing a minute stream of electric light against the sensitive surface of the plate thus exposing that portion of the same directly underlying the device, so that when the plate is developed and the positive printed the title will be present.

VOLTAGE-CONTROLLING DEVICE FOR DYNAMOS.—G. C. Hubble, Box 408, Bonners Ferry, Idaho. The invention relates to a device for controlling the field winding of dynamos. An object resides in the provision of means whereby the field excitation of dynamos can be sensitively controlled by automatic means which is actuated in accordance with load variations of the dynamo. A further object is to provide a controlling means applicable to dynamos with a minimum necessity for alteration in their construction.

SIGNALING MECHANISM.—J C Sims, 28 Walnut St., Maynard, Mass. The invention relates to an electrically operated visual and sounding signal, an object being to provide a signal which may be seen and heard by night or by daylight, and which will be automatically operated. A further object is to provide a signaling mechanism which is adapted for use as a railroad signal, a burglar alarm or for any other use to which such a device might be applied.

Of Interest to Farmers

SILO.—J Mattson, 153 W Chestnut St., Chicago, Ill An object of the invention is to provide a silo having a flexible closure supported for movement vertically, said closure being adapted to comfortably fit within the silo casing at all times. A further object is to provide means for balancing the weight of the closure to insure ease of operation. The device is simple and can be produced with the materials ordinarily available.

TRANSPLANTING DEVICE.—H. D Elliott, Tabor, N C The invention relates more particularly to a device adapted for planting potatoes, sprouts, vines, and the like. An object is to provide a simple device in the nature of a handled implement like a shovel or spading fork, which will serve to form the desired cavity in the ground to receive the plant, and to supply the necessary water or fertilizing mixture to assist the plant in taking root.

PORTABLE COMBINED COTTON PICKING, GINNING, CONDENSING AND COMPRESSING MACHINE.—Mary W Silverthorne, 34 W 53d St., New York, N Y The most important feature of this invention resides in the combining of cotton picking, ginning, condensing and compressing mechanism on a vehicle to render the machine portable and capable of being moved into a field as an entire unit so that the complete operations from the picking of the cot ton to the baling thereof may be finished on the field, with a minimum number of helpers, the cotton being transferred from one process to another by a continuous air current. (See Fig 1.)

BACKBAND HOOK.—E. W Bailey, Lawley, Ala. The invention relates to hooks for the backband of draft animals, the principal object being to provide a hook which will serve to firmly support the trace chain and prevent the same from slipping in either direction A further object is to provide a hook so constructed that a trace chain may be readily attached thereto, and a hook which will be simple and practical in construction, strong and durable in use, and inexpensive to manufacture (See Fig 2.)

SPRAYING DEVICE.—A A. Sturdivant, Spooner, Wis. The invention relates to a device for spraying a liquid upon plants in the field. An object is to provide a flexible attachment for a movable spraying machine which will co act with the latter to bend standing plants at the time the liquid is discharged so that the plants, including insects clinging to the under side, will be drenched with the spray solution The device may be adjusted for use on plants of various heights.

Of General Interest

ATTACHING MEANS FOR SEPARABLE FASTENER ELEMENTS.—B Z Hausner, c/o Empire Notion Co., 72 Madison Ave., New York, N Y The invention relates to means for attaching separable fastener elements to a support, particularly to means for attaching snap fasteners to paper envelopes, folders or cardboard box closures, and resides broadly in the use of adhesives for this purpose. The primary object is to provide attaching means which firmly hold the fasteners and which will be simple and practical in use. (See Fig 3)

VANITY CASE.—W G Kendall, 118 Market St., Newark, N J Among the objects of the invention is to provide a vanity case, the body of which is divided into two compartments, and having a removable bottom plate, together with the provision of means whereby this plate automatically locks itself within the case upon its insertion One of the principal objects is the construction of a case in which the comparts carried may be renewed from time to time without defacing the case

MAIL RECEPTACLE.—N Panagopoulos, c/o Brainerd & Cotwals, 411 Surety Bldg, Muskogee Okla. The invention relates more particularly to receptacles for mail deposit and collection boxes, the object being the provision of a receptacle including a pouch bodily shiftable into and out of the mail box with means to receive therein deposited mail so that the collector need not handle individual pieces of mail but may withdraw the deposited mail in a single operation

LAST FOR SHOES AND SANDALS.—J Thomas, 210½ Heron St., Aberdeen, Wash. The general object of the invention is to provide a last adapted to be placed against the shoe at the exterior instead of being inserted in the shoe. A further object is to provide a last that will enable the sole to be fastened neatly, and practically invisibly, by nailing with the edge of the sole placed against the last disposed at the exterior of the sandal

AWNING CONSTRUCTION.—W F O'Donnell and C Seybold, c/o W F O'Donnell, 524 W 78th St, Chicago, Ill Among the objects of this invention is to provide an awning construction having means for controlling the operation of the awning from the interior of the structure, such as a dwelling, to which the device is applied, and means for partially housing the awning fabric to protect the same from rain, snow, and the like. The device may be applied to a window frame of ordinary construction without extensive alterations of the latter

IRONING BOARD.—R. A. Morrison and F L. Oswald, 1007 Board of Trade Bldg., Portland, Oregon. The invention relates to folding ironing boards. The object is to provide a board with three legs which folds and unfolds easily, which requires no fastening means such as hooks or similar attachments, which when extended will have the necessary rigidity to facilitate the iron ing operation without requiring unnecessary effort, which permits the ironer to stand directly over the work, and on which the entire surface is solid under pressure.

FLY HOOK AND LEADER.—P F Halferty, 814 E. Pike St., Seattle, Wash The general object of the invention is to provide a quick detachable fish hook and to provide a leader with snells so connected that the use of the undesirable loops now employed is obviated, as well as to provide a knot on the lower end of the leader particularly adapted to coact with the hook. While adapted for use with plain hooks to receive a bait, the device is particularly useful for a fly hook and leader

GREASE GUN.—J M Mills, c/o State Nursery Co, Helena, Montana. An object of this invention is to provide a device having a hinged, spring-held nozzle which can be moved to one side and permit the gun to be loaded at the nozzle end A further object is to provide a special form of plunger, and a construction of gun which will be strong and practical in use.

ADJUSTABLE FORM TIE AND SPACER.—J C Buchenau, 202 Lillian Ave., Eastwood Sta., Syracuse, N Y The invention relates to a wall mold or form and the general object is the provision of a device adapted to constitute an adjustable tie and spacer between the sides of the form. A more specific object is to provide for adjustably connecting the sections without the employment of bolts, screws or other fastening means.

CLAMP FOR ROOFS.—C. C. White, c/o R. C. Cowen, Gulfport, Miss. The general object of the invention is to provide clamps for use on roofs in various portions at the joints, at the overlapped shingles, at the peak, and as an edging for the roof, whereby to make the roof water-tight and keep it from buckling or warping, as well as to prevent nails when over-driven from damaging the roof, and in addition, the roof is given a better appearance

CONCRETE STRUCTURE.—J A. White, 2320 6th Ave., Seattle, Wash. The invention relates to concrete structure adapted to be employed in the construction of dwellings. The object is to provide structures so arranged and related that when assembled they present great strength and rigidity, the walls being substantially hol low Another object is to provide a structure with means whereby the interior finish ing of floors, ceilings or side walls may be easily and securely fastened to the wall proper

BUILDING CONSTRUCTION.—R. H. Irwin, R. F D No 4, Box 32, Medford, Conn The invention aims to provide a building especially adapted for use as a garage, or for storage purposes. The object is to construct a building in such a manner that space heretofore wasted will be used to the fullest extent and that vehicles stored therein will be readily available and that backing will be practically eliminated, the vehicles after entering the building being placed upon a turntable and brought in direct contact with the compartment to be occupied. (See Fig 4)

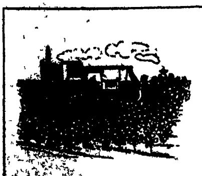


Fig. 1: [illegible] attachment in the cotton [illegible], as devised by [illegible]

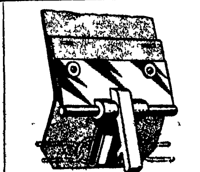


Fig. 2: E. W. Bailey's improved backband hook leads to more effective harnessing of draft animals

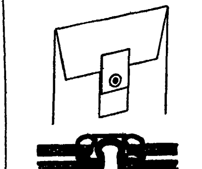


Fig 3: Better operation of snap fasteners is the aim of B. Z. Hausner's invention, pictured here

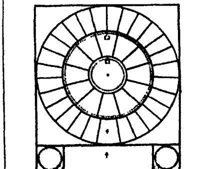


Fig. 4: Ground plan of R. H. Irwin's circular turntable-equipped garage that eliminates backing around

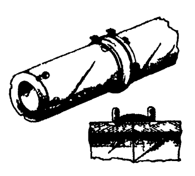


Fig 5: R W Higdon's invention gives a better sealed joint for pipe sections than heretofore

Fig 6: A new way of keeping the water separate from the cooling ice, patented by J Raggio and F Bongiorni

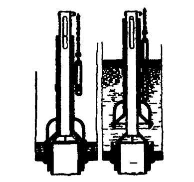


Fig 7 More certain and effective operation is claimed for T J Cahill's new flush valve

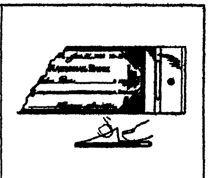


Fig 8: R. Bates invention comprises check-protective means embodied in the check and the check book and available for use at all times and places

TAG—L L MOORE and F W RADCLIFFE 936 So New Hampshire St Los Angeles Calif An object of the invention is to provide a tag for highly polished and delicate articles such as silverware and jewelry likely to be scratched by ordinary price tags A further object is to provide a cloth covering constituting a means for protecting the tag from engagement with the articles to which it is attached

CONVERTIBLE FURNITURE —LORA F HOLMES 277 Hillyer Ave Macon Ga The invention particularly relates to a kitchen cabinet. The object is to provide a cabinet of artistic appearance and durable service which will save much room and will serve for the storage of unprepared food and cooking utensils and which may be quickly converted into a table when desired

PIPE JOINT — R W HIGDON 741 Peachtree St Atlanta Ga The object of this invention is to provide means for connecting the meeting ends of a pair of terra cotta or similar pipe sections in such a manner that the sections are securely held in alinement A further object is to provide a pipe joint which utilizes cement in a more or less semi fluid state to connect the sections and firmly hold the joining keys within the sockets or grooves provided for that purpose (See Fig 5)

CUE TIP FASTENER—H I GRENIER c/o Mrs Jacobs 141 Grasmere Ave Fairfield Conn The invention pertains broadly to billiard cues and more particularly to the provision of fastening means for a cue attachment of the kind comprising a tip and a backing element on which the tip is to be secured Among the objects is to provide flexible wire members embedded in the tip and passed through holes in the backing element which when screwed down on the arc will serve to finally clamp the tip

CALENDAR—W H BAKER, 1001 F 9th St Newton Kan An object of the invention is to provide a calendar which may be used for a period of 12 years or more A further object is to provide means for bringing the various days and years into registration with an opening so that the desired month and year may be viewed The device is simple and not likely to easily get out of order

SHOE FASTENER—B M KIRIN 38 F 85th St New York N Y The primary object is to provide a shoe string holder which is simple in construction and operation Another object is to provide a shoe-string holder which is readily attached to the upper edge of the shoe to receive the loops of the knot of the shoe lace the holder being adjustable to hold loops of various lengths and to be easily removed by the user when not desired

CAMERA—V CALABRESE 1152 49th St Brooklyn N Y Among the objects of the invention is to provide a film winding mechanism which may be operated to position an unexposed section of the film strip behind the shutter opening after each operation of the shutter A further object is to provide an automatic winding of the film by which the paper strip on the film will be wound upon the spool before the first exposure and after the last in order that the spool may be removed from the camera without danger to the exposed sections

COMBINATION FURNITURE—A L NEIL 542 50th St. Brooklyn N Y An object of this invention is to provide a combined table and ironing board the ironing board being of the folding type. A further object is to so construct the ironing board that it will be foldable within the table when not in use and supported by the table when in operative position

POWDER PUFF—J E B MAILLARD Coulombs par Nogent le Roy France The invention has for its object to provide a device so arranged that the powder is enclosed between a support and a permeable surface which prevents it from freely escaping while it can be pressed between the two surfaces and thereby distributed by degrees until the powder is completely used up

TIME INDICATOR—C W JAEGER c/o Bank of Westby Westby Wis The invention relates to direct reading indicating or computing devices An object is to provide a device for use in banks and like institutions in the calculating of the number of days occurring between two given dates A further object is to provide a device having means for disclosing results without any manipulation of the device being required beyond an initial adjustment.

SILICATE COMPOSITION—L SEIDEMAN 240 W 113th St New York N Y An object of this invention is to provide a silicate composition adapted to serve as a bronzing or other metallic paint liquid or vehicle as a leather dressing or as a substitute for varnish and shellac which is incombustible inodorous dries quickly with a brilliant gloss and mixes well with bronze powder inks or dyes The composition comprises sodium silicate having a density of 40 deg Bé and corn oil

BINDING CASE FOR HOLDING SHEET MUSIC AND THE LIKE—J W WEST 9 Bushey Hill Rd Peckham Rd Camberwell London S E 5 England The invention relates to binding cases for holding sheet music and other double leaf papers The primary object of the invention is to provide a binding case so constructed as to allow any selected paper contained therein to lie flat without tendency to curl upwards when the binding case is laid open so as to expose the particular paper selected

GRAND STAND CONSTRUCTION—R J LAMBERT 5 Fairchild St Iowa City Iowa The general object of the invention is to provide a grand stand structure formed of steel plates in step form providing on the treads thereof seats the structure as a whole reflecting practical considerations with respect to strength and simplicity of construction arrangement of bracing and the character of the seats

RECEPTACLE—J RAGGIO and F BONGIORNI 617 53rd St. Brooklyn N Y One of the principal objects of the invention resides in the provision of a receptacle for drinking water which includes a separate compartment for ice as a cooling medium whereby the practice of placing the ice directly in the water is eliminated The invention further aims to provide means for drawing off the water from the melted ice without emptying the receptacle proper (See Fig 6.)

COLLAPSIBLE DRAWING BOARD—L L OBERWARTH Frankfort Ky The invention has for its object to provide a collapsible drawing board which comprises a minimum number of parts which can be quickly and readily assembled or disassembled and when disassembled can be packed in a small space for transportation and the convenience of a traveling man The device is not intended as a piece of office furniture.

CHECK PERFORATOR. — R. BATES Box 117, Nevada Mo Among the objects of the invention is to provide a simple device that may be employed to quickly perforate a check following the lines of the letters and numerals in the amount for which the check is drawn The device is portable and will serve to prevent tampering with the check after once drawn

OUTLET VALVE FOR FLUSH TANKS—T J CAHILL, 810 Carrizo St Corpus Christi Texas The invention relates generally to outlet valves for flush tanks of toilet bowls The main object is to provide a valve which is constructed in such a manner as to trap a volume of air whereby upon the initial lifting of the valve the air trapped therein will operate to buoy the valve in the water until the emptying of the tank is effected (See Fig 7)

BANK CHECK AND CHECK BOOK—R BATES Box 117 Nevada Mo An object of this invention is to provide a safety check to prevent the check being raised materially beyond the amount for which it is drawn A further object is to provide a check book having a cutter or severing attachment for detaching a corner or corners of the check designating the monetary value nearest the amount for which the check is drawn (See Fig 8)

DISPLAY EASEL—G A DONALDSON Girard Ill The invention relates to display easels of thin material such as cardboard celluloid sheet metal or the like an object being to provide means for preventing accidental movement of the back stay when the latter is in operative position A further object is to provide a back stay which will fold flat and an attachment which will hold the back stay at right angles to the face

PLANT RECEPTACLE—F C WEIDIG 30 Carrollin Ave New Orleans La An object of the invention is to provide a baffled drain outlet in the bottom of a plant receptacle which will permit an excess of water to escape but which will hold back the earth in the receptacle The device is intended to be applied to what are commonly termed concrete or cement pots " boxes or vases

TOY FURNITURE — A DUFFIELD Derby Conn Among the objects of the invention is to provide elements or units of construction which when united will form various articles of furniture A further object is to provide toy furniture made up of sheet metal parts having an arrangement of coupling which enable the parts to be readily assembled and which will be strong and durable to withstand rough usage

VALVE—W R SMITH Lompoc Calif. This invention while relating in general to valves has reference more particularly to a construction which is especially applicable to irrigating and the like systems of water distribution The primary object is to produce a valve which is simple in construction yet capable of carrying out its intended use with efficiency and convenience both in installing and manner of operation

CONCRETE WALL CONSTRUCTION—A H NELSON 580 N Center St, Turlock Calif The principal object of the invention is to provide a convenient means for constructing a hollow concrete wall A further object is to provide a form by means of which the wall may be constructed shipwise and during the construction reinforcing members holding the walls in spaced relation may be introduced without in any manner interfering with the proper operation of the form

STEREOPTICON DEVICE.—W H C. DUDLEY Americus, Ga The invention relates generally to picture projecting machines and more particularly to the projection of stereopticon pictures for printed matter for advertising purposes. The purpose is to provide a simple and inexpensive stereopticon device designed for attachment to the lamp housing of a motion picture projecting apparatus, by means of which advertising matter on a transparent strip of film may be projected and displayed.

FILM HOLDER.—C. S HOWLAND, 124 Campbell St New Bedford Mass The invention particularly relates to film holding frames adapted to be used in the process of developing X ray films An object is to provide a holder which will firmly grip a film and may be used to hold the film in the developing and washing and also as a support while the film is drying

SCAFFOLD.—W J MURRAY 88 Barry Ave Mamaroneck, N Y The general object of the invention is to provide a raising and lowering means of simple construction adapted to wind in and pay out the suspending ropes or cables in the raising and lowering of a scaffold the special object being to insure safety and positively and automatically preventing the accidental dropping of the scaffold either at one or both ends

CLOTHESLINE REEL—J MIESSNER, 1333 W 85th St Cleveland Ohio Among the objects of the invention is to provide a reel which facilitates the putting up or taking down of a clothes line in that it allows any desired length of line to be used without danger of dragging the line on the ground A further object is to provide means which prevent twisting and injurious bending of the line compelling it to wind smoothly and thereby lengthen the life of the line

HAIR CURLER—E CALKINS 516 No 7th St. St Joseph Mo An object of the invention is to provide a covered wire pad with an arrangement of covered wire projecting through the curler and having looped ends which permit the ends to be bent over the hair after the latter is wound on the main portion of the curler and to prevent possibility of entangling the wire in the hair

TABLE-SLIDE CONSTRUCTION—E H COOK 100 Main St Watertown, Wis An object of the invention is to provide a table slide construction in which the sliding members have L grooves so constructed as to provide the maximum amount of supporting surface to the plates connecting the members together A further object is to provide a device in which the end sliding members are adapted to be raised slightly so as to prevent the sagging of the ends of the table

BAG—A. J FARNSWORTH and E M ST CLAIR 516 Sutter St San Francisco, Calif This invention relates to bags that are intended for suspension from supporting devices, and particularly to such bags when made of paper or easily torn material the purpose is to provide a simple and inexpensive bag that can be suspended in such manner that the weight of its contents will be sustained by a relatively large portion of its periphery

ACOUSTIC DEVICE—H D BROWN, c/o A Feinberg 280 Madison Ave, New York N Y The invention aims to provide a device adapted to be worn upon the person of those whose hearing is defective for the purpose of transmitting and intensifying sound waves and vibrations to the inner ear in order to alleviate discomforts caused by defective hearing, the sound waves being transmitted to the ear at a point opposite the petromastoid portion of the temporal bone

ASSOCIATION VANITY BOX.—A E. MORR, Hilyer Hall, 102 Hanson St., Brooklyn, N Y An object of the invention is to provide a neat and attractive assemblage of containers in which articles and material may be supported which a lady may need, and which will facilitate the use of the contents of the device. A further object is to provide a device in which a plurality of separate containers are rigidly secured in a neat and ornamental assemblage.

BUTTON.—R. L. Huffman, Box 33, Brookfield, Mo. The general object of this invention is the provision of a button of simple construction with means for attaching it to any fabric, the button being provided with a neck which serves to retain the button body spaced from the fabric so that another fabric may be easily attached, the neck of the button having mounted on its inner wall hook-engaging means with which the resilient hooks of an attaching means engage. (See Fig. 9.)

BURIAL APPARATUS.—J D Jennings, 72 Meeting St., Charleston, S. C This invention relates particularly to an apparatus designed to receive the earth from a freshly dug grave and hold the same until such time as it is desired to refill the grave, at which time the apparatus functions to deposit said earth in the grave in substantially a unit mass. An object is to provide an apparatus which may be folded into compact form and readily transported, with a minimum of time and labor (See Fig 10.)

REFRIGERATOR AND COOLER.—W M. Rapp, c/o Vapo Corporation, 165 Sutter St., San Francisco, Cal. This inventor has been granted two patents of a similar nature, they relate in general to refrigerators for preserving food stuffs, and have reference more particularly to a so-called iceless refrigerator in which a receptacle is equipped with means for storing food stuff, which is so constructed that with the aid of a liquid evaporation, preferably the evaporation of water, the food may be maintained in a perfect state of preservation The object is to provide such a receptacle which will be properly ventilated, maintain a cooling and refrigerating medium, and may be produced at a comparatively low cost.

PIVOT BUTTON—M. Weiss, 148 Beach 74th St., Arverne, N Y The object of this invention is to provide a simple and efficient button of the pivot type designed to carry a cloth cover and which may be readily attached to or detached from any fabric. Among the purposes is to provide a button for ornamental purposes which will set close to the fabric to which it is attached.

ROLLER SCREEN.—F R. Kornis, c/o W H Jackson Co., 2 W 47th St., New York, N Y The primary object of this invention is to provide a screen of the roller type especially adapted for use as a protecting screen for fireplace openings. A further object is to provide a screen which may be adjusted to various positions relative to the opening without sagging and without the aid of a positively locking means.

SINKER.—S. Mills, c/o Mrs. Anna Aldrich, 189 W 128th St., New York, N Y This invention relates to sinkers for fishlines, and has for a general object to provide a sinker so formed as to result in a better hold on the bottom of the water, so that a sinker of medium weight may be employed The increased holding action furthermore requires less paying out of the line as compared with an ordinary sinker of equal weight, resulting in less strain on the pole and tackle.

TANK.—J W Keelin, East Millstone, N J An object of the invention is to provide a tank in which combustible and explosive material may be stored and at the same time protected against fire. A further object is to provide a tank in which the parts are so formed that one or more walls or sheets of water is provided around the tank for preventing explosions or burning of the contents of the tank.

VANITY CASE.—S. Albert, 370 Riverside Drive, New York, N Y The invention relates to a container adapted to hold toilet articles. An object is to provide a case which embodies in one article means for holding a plurality of articles in separate relation and in such manner that each of the articles held is readily accessible for use, and at the same time to render the case particularly suitable for carrying about in a small space, as, for instance, a pocket or handbag (See Fig. 11.)

ELEVATOR INTERLOCKING DEVICE.—J. E. W Fogal, c/o Fogal-Williams Safety Devices Co., Quincy, Ill Among the objects of this invention is to provide a combination latch for elevator doors and interlocking safety device which is simple in construction and in which the electrical points of contact are thoroughly insulated A further object is to provide a device which may be readily attached to the ordinary type of elevator door

DOOR-OPENING DEVICE.—J E. W Fogal, 1705 State St., Quincy, Ill. The invention particularly relates to a device for operating folding doors. An object is to provide a device having means for locking the sections of the door in closed position and for preventing relative movement of the door until the locking mechanism has been actuated to release the door The parts are arranged for movement without binding and with very little friction

Hardware and Tools

HAIR CLIPPER.—C Nannini, Manhattan, Nevada. This invention relates in general to hair clippers as commonly used by barbers, but has reference more particularly to means in the nature of an adjustable attachment to enable the clippers to be used for cutting relatively long hair, as well as medium and short length hair, all over the head, without the necessity of using shears.

KNIFE.—L B Bates c/o Robert Storie, Waterville, Maine The invention has particular reference to folding knives. Among the objects is to provide in combination with a folding knife means for positively locking the blade respectively in opened and closed positions, and means for releasing said locking means A further object is to provide means for effecting an initial opening and movement of the blade. The knife is comparatively simple in construction and operation, and inexpensive to manufacture.

DENTAL TOOL.—G G Bell, Ashland, Ky The invention particularly relates to a tool in which a plurality of teeth are provided, adapted to move in various circular pairs when the tool is rotated, for the removal of the excess plaster from a plaster of paris model, and for the shaping up of the model so that it may properly fit within a flask.

LOCK.—M. Arm, 1412 Wilkins Ave, New York, N Y An object of the invention is the provision of means whereby the lock may be operated either by a knob or by a key, and whereby whenever the knob is used to actuate the lock the connection between the bolt and the key-operating means may be removed. A further object resides in the provision of a lock bolt of particular construction whereby a double engagement between the casing on the jamb and the casing on the door is effected

NAIL PULLER.—J B. Bradley, Box 1230 Miami, Fla. An object of the invention is to provide a simple and effective tool which is adapted to be used by cabinet makers, joiners, carpenters, and others working in wood, to occasion the withdrawal of nails driven into wood. A further object is to provide a tool which facilitates the drawing of deeply driven nails without causing any appreciable injury to the article from which the nail is removed.

VISE.—W Sury, Pieterlen, Switzerland One of the principal objects of the invention is to provide a vise which is quick acting in that the jaws may be easily adjusted to their approximate positions without necessity of continuously rotating the main operating screw while at the same time not impairing the effectiveness of the screw when it is brought into action A further object is to provide a vise which is strong and capable of exerting a very powerful gripping action on the work engaged

COMBINATION DOORKNOB AND RINGING DEVICE.—E. B. Calderwood, 1520 Franklin St., Oakland, Calif The particular object of the invention is to provide a ringing device hidden in a doorknob that will sound an alarm when the knob is turned in either direction The device is constructed in such a manner that its outer appearance does not in any way indicate that a ringing device is connected therewith, and a simple means renders the alarm inoperative when desired

LOCKING BOLT.—S. W Band, 580 Valencia St, San Francisco, Calif The primary object of the invention is to provide means which may be conveniently used for permanently or temporarily clamping plates or the like The device is especially adapted for use where it is desirable to clamp two or more plates together preparatory to rivet ing or otherwise fixing them together

LAWN EDGE TRIMMER.—J Leks, 133 So West St, Allentown, Pa. One of the foremost objects of the invention is to provide a cutting implement for edging that portion of a lawn at the sides of a cement or other sidewalk, a turf remover and cutting gage being included as elements of the implement. A further object is to provide a tool in which the cutting gage is adjustable so that different widths of turf can be removed as desired

CASTER.—H R Knaack, 144 N Lincoln St, Chicago Ill An object of the invention is to provide a caster that is applicable to various articles of furniture, trucks, and the like, and has means for holding a ball member so that the latter has a rolling contact with the floor A further object is to provide a device having means for holding a ball member in operative engagement with a floor and for preventing friction between the movable parts.

Heating and Lighting

GAS HEATER.—C Van Santvoort 331 South Ave Waukegan, Ill An object of the invention is to provide a gas heater in which the heated air is by passed through a plurality of radiating pipes before it is expelled into the room A further object is the provision of a device in which the heated air first flows outwardly from the center, then upwardly along the sides and then out at the rear the air in the room being drawn by the heated pipes and warmed thereby

OIL BURNER.—W K. Lewis, 1918 House St Cheyenne, Wyo. An object of this invention is to provide a burner which is adapted to be arranged within furnaces and heating plants originally constructed for the use of coal or the like, as a fuel, whereby hydrocarbon fuel, such as various grades of oils may be used for such furnaces without extensive changes, if any, in the ordinary construction A further object is to so construct the burner as to direct the flame occasioned by the combustion of the fuel radially diffusing the heat over a maximum area

STEAMING CABINET.—L. Angelus, c/o Circle Pleating Outfit Co., 52 W 31st St., New York, N Y Among the objects of this invention is the provision of means whereby articles placed within the cabinet to be steamed are properly and effectually steamed without becoming wet, and effectually steamed on all sides. A further object resides in the provision of means whereby the articles are kept out of contact with the walls of the cabinet, and the condensation of steam properly absorbed.

Machines and Mechanical Devices

ATTACHMENT FOR GATHERERS ON SEWING MACHINES.—H A. Pulliam, Box 72, Frankfort, Ky This invention relates to a seam ripping attachment to be applied to a sewing machine. The invention coordinates the gatherer and an oscillating blade for severing the stitches, movements being imparted to the blade by a reciprocating member associated with the well-known form of gatherer employed on sewing machines.

POWER-TRANSMISSION MECHANISM.—J Impellizzeri, 192 Meserole St., Brooklyn, N Y The general object of the invention is the provision of a simple and durable power transmission device that may be mounted in conjunction with any machine and adjusted to transmit power along different lines. A further object is the provision of a transmission device, the gears and clutch wheels of which are so mounted that they are held against movement lengthwise of their shafts.

RECORDING DEVICE FOR LIQUID PUMPS.—A B Snyder, Grass Valley, Calif The invention has particular reference to oil dispensing pumps such as are commonly used in automobile supply stations. The device is intended for use as dispensing means in cooperation with a faucet, and to provide an automatic means of eliminating any errors of the operator in the failure to record the sale made.

ROD ELEVATOR.—C E. Sitzman, Lost Hills, Calif An important object of the invention is to provide a device adapted for use in lifting the rod or tube of an oil well, and means whereby the same may be operatively connected to the upper portion of the sucker rod so that when an upward pull is exerted on the device the sucker rod will be elevated, and means whereby the operator may release the device by a spring without possibility of injury to himself.

CLEANING BRUSH.—E. Grieger, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N Y An object of this invention is to provide a power-driven brush such as is utilized for cleaning surfaces, and an operating mechanism therefor, which will be adjustable to virtually all planes and which will further be primarily adapted to cooperate with the surface to be cleaned, which surface is disposed at an angle to the mounting of the brush

HEEL CUTTING MACHINE.—A. Schoen, c/o Schmidt, 1237 College Ave., Bronx, N Y This inventor has been granted two patents of a similar nature, they relate to shoe machinery for trimming the front of heels, the object being to provide a construction wherein the unfinished heels may be fed into the machine and automatically cut at the proper place, the arrangement being such that the heels are manually placed in the machine and automatically moved to the cutter and the heel fronts cut without any further consideration by the operator the construction includes a rotatable platform with holders for the heels, and the speed of cutting may be varied (See Fig 12)

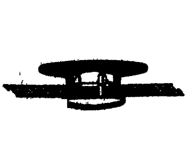


Fig. 9: R. L. Huffman provides a button that [illegible]

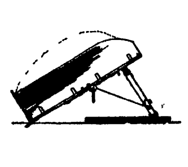


Fig. 10: J. D. Jennings brings the benefits of invention to the grave-digger, simplifying the task of refilling the grave

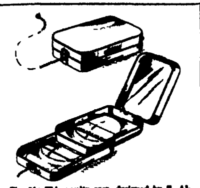


Fig. 11: This vanity case, designed by S. Albert, provides instant access to each of its contained articles

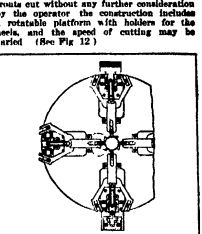


Fig. 12: A. Schoen's improved machinery for trimming the fronts of shoe-heels

CONTROL HEAD.—D. Bresding, Box 664, Mexia, Texas. The invention relates to well-drilling apparatus, wherein valves are provided which prevent an escapement of oil from the control head while the usual oil sealing device is being applied or removed. A purpose is the provision of a control head in which the valves are supported for movement in arcs of the same circle so that in closed position their confronting edges meet and thus provide a more efficient seal for preventing the passage of oil between the valves and drill cable.

DEVICE FOR STRAIGHTENING PHOTOGRAPHIC PRINTS.—C. H. Riss, Rapid City, S. D. The invention relates to a mechanical device for straightening photographic prints which have become curled during the process of drying. The object is to provide a device which includes an endless belt trained over supporting rollers and a simple means, whereby to cause the same to run true, and means adapted to coact with the belt for delivering the straightened prints therefrom in an orderly manner.

APPARATUS FOR HEAPING OR PILING UP PACKAGES, BAGS, AND THE LIKE.—J. C. Thouviot, Paris-L'Hospital, Saone and Loire, France. The invention has for its object to provide a device for taking packages from the ground or from a floor and piling them either on a platform or above the ground. The device is arranged in such manner that the whole of the apparatus may be raised or lowered on wheels, and pushed to required place and the load deposited.

SPLIT HUB HEAD FOR CYLINDERS FOR SPINNING FRAMES, SPOOLERS, AND CYLINDERS OF LIKE NATURE.—W. Herron and J. H. Jester, address John P. King Mfg. Co., Augusta, Ga. Among the objects of the invention is to provide a spinning frame cylinder which is constructed in such manner as to permit of the disassembly of the cylinder and the removal or replacement of the shaft upon which the cylinder is mounted with the necessity of removing the cylinder from the cylinder frame obviated.

AUTOMATIC BEARING ADJUSTER.—J. F. Ross, c/o Kil Nock Co., Davenport, Iowa. An object of the invention is to provide a device that is adapted to be applied to a bearing and is automatically operated to adjust the parts of the bearing relatively in order to compensate for wear on the bearing and on a member journaled therein. A further object is to provide a device in which the adjustment of the parts is effected by spring actuated means. The device is adapted to be applied to an ordinary bearing without extensive changes.

POULTRY DIPPING MACHINE.—C. E. Hedrick, c/o Automatic Poultry Dipper Co., Wichita, Kan. An object of the invention is to provide means for removing vermin and scale from the body and legs of fowls, and for automatically dipping the poultry, and thereby relieving the caretaker of the tedious method. The device consists of a runway adapted to be put in communication with the outlet of the poultry house provided with a hinged bottom which will automatically drop the poultry by their own weight into the germicidal fluid.

WARPER SEAT.—A. J. Palin, c/o A. M. Suprenant, 200 Oak Hall Bldg., Pawtucket, R. I. This invention relates to seats adapted to be attached to a warping machine, to provide a rest for operators. An object is to provide a device adapted to be attached in a desirable position with respect to a control member of the warping machine, or moved out of the way when not in use, and which embodies means operable by the weight of an operator to operate the control member of the machine.

Medical Devices

BED BATHING APPARATUS.—L. E. Reanier, 1507 Hill St., Seattle, Wash. The object of the invention is to provide an apparatus which may be easily and quickly attached to a bed and arranged for bathing a patient in the bed without greatly disturbing the patient. A further object is to so construct the apparatus that it may be easily folded into a compact bundle and transported from place to place by a nurse or other person.

SUPPORT FOR INVALIDS.—G. Kennedy, 50 So. Dunlap St., Memphis, Tenn. Among the objects of the invention is to provide a support which may be conveniently associated with hospital beds or any type of bed to provide a convenient support for maintaining the invalid or patient in semi-fallen position. By the use of this device the patient is maintained in proper position although not so restrained as to preclude him from partaking of such movements as are proper and necessary.

SURGICAL INSTRUMENT.—D. Lo Giudice, c/o George Tiemann & Co., 107 Park Row, New York, N. Y. An object of the invention is the construction of a surgical instrument by means of which the tonsils may be removed from the mouth of a patient without any danger of becoming lodged in the throat, aside from the fact that a severance of the tissue is permitted by means of this device in a more rapid manner, and with less danger of a hemorrhage.

TRUSS.—W. Schuerg, Menard, Texas. The invention relates particularly to a truss in which provision is made for the alleviation of what are known as scrotal ruptures, the primary object being the provision of a simple, inexpensive form of truss which may be firmly and evenly maintained in proper place with minimum discomfort.

Musical Devices

LEAF TURNER.—D. Horcks, 894 Vanderbilt Ave., Brooklyn, N. Y. One of the principal objects of the invention is to provide a mechanical means for successively turning leaves or sheets whereby musicians or the like will be relieved of the necessity of turning the same by hand. A further object is to provide turning mechanism in the form of a clip which may be readily applied to a piano or the like, and a pedal or push button actuating means for turning the sheets.

Prime Movers and Their Accessories

CARBURETOR.—A. H. Webber, 349 Columbus Ave., Boston, Mass. It is an object of the invention to provide a carburetor which will produce an extremely efficient mixture during idling, and high speed and will additionally produce an efficient accelerating mixture causing the motor to readily take hold during this interval, and virtually precludes any danger of the same stalling, upon its being suddenly subjected to a load, at a relatively low engine speed.

GASEOUS FUEL MIXTURE.—D. Bonnell, 109 W. Hickmann St., Winchester, Ky. The invention particularly relates to a device for mixing the gas fuel elements of internal combustion engines. An object is to provide a device of simple construction which may be placed in the pipe leading from the carburetor to the manifold of the engine, and secured by a mechanism having no movable parts, thus avoiding likelihood of loss or derangement, and avoiding the improper introduction of raw gas into the engine.

VALVE-TAPPET SILENCER.—G. W. Mosey and C. K. Mosey, 428 10th Ave., Seattle, Wash. The primary object of the invention is to provide a simple and inexpensive means to relieve the noisy condition caused by the play between the rods and tappets, and further to so construct the silencing means that it may be readily incorporated in the engine structure without necessarily changing the engine to accommodate the same.

ROTARY ENGINE.—S. E. Kochendarfer, 407 Tudor Hall, Mass. Ave. and 10th St., Washington, Pa. An object of the invention is to provide a rotary engine embodying means for automatically and gradually cutting off the flow of fluid into the working chamber with means consisting of the mutually associated and cooperating piston and cam crescent against which it works during a portion of the rotation.

Pertaining to Vehicles

DUMPING BODY FOR VEHICLES.—C. A. Holt, Jr., 2001 30th St., Galveston, Texas. An object of this invention is to provide a side dumping body for automobile trucks and all other vehicles which will enable the carrying and separate dumping of two different materials, or the ready and convenient carrying and simultaneous dumping of the same material. The dumping bodies consist of two lengthwise parallel and sidewise abutting sections, with mechanism for elevating the same from the center of the truck to dumping position.

VEHICLE WHEEL.—A. Freund, Box 733, Central Station, St. Louis, Mo. This inventor has been granted two patents of a similar nature relating to pneumatic resilient wheels in which the inflated tire structure thereof is isolated from contact with the road in order to minimize wear thereon. The object is to provide a wheel structure which functions precisely in the capacity of the ordinary wheel equipped with a pneumatic tire, but in which a solid rubber tread is presented to the road surface to prevent punctures or stone bruises. Means are provided for connecting the inner and outer fellies by a plurality of telescoping sections secured to the respective fellies.

AUTOMATIC BRAKE FOR MOTOR VEHICLES.—J. Perlin, 1408 N. Kimball Ave., Chicago, Ill. The invention more particularly relates to a safety brake for automobiles, trucks and the like. An object is to provide a brake which will automatically bring the car to a stop when it strikes an obstacle, and to provide automatic means for placing anti-skid members underneath the rear wheels when the car has struck an obstacle. The device is simple, strong and not likely to get out of order.

TRUCK UNLOADER.—A. W. Eccm, 401 Collins St., Joliet, Ill. An object of the invention is to provide an unloading device having a tiltable body and having means for conveying the load from the truck to a selected place. A further object is to provide a device that can be positioned in desired angular relations with respect to intersecting horizontal and vertical median planes, whereby the load can be deposited at various elevations either directly to the rear of the truck or at either side thereof.

GEARING.—A. Seniw, 70 Richard Ave., Glendale, N. Y. One of the objects of the invention is to provide a gearing in which two shafts may be driven in one direction and more power may be applied to the shafts than is possible in the ordinary form of gearing. A further object is to provide a gearing of this type in which the gears carried by the shafts to be driven are driven upon opposite sides of their respective shafts.

AUTOMOBILE TOP.—S. H. Summerscales, Box 1891, Winnipeg, Manitoba, Canada. Among the objects is to provide a construction which may be easily manipulated so as to be confined within the walls of the body or extended above the top of the body, and to provide a folding top so constructed that it may be collapsed in such a manner as to be nested without the necessity of taking the same apart.

PERMUTATION LOCK FOR IGNITION SYSTEMS.—F. O. Willey, 1815 Southeastern Ave., Indianapolis, Ind. The general object of this invention is to provide a device applicable to the coil box of an automobile for locking the coil elements to prevent surreptitious removal of the coils. An important object is to provide an embodiment of the locking means which will at the same time short-circuit the coil.

TIRE CARRIER.—J. S. Kern, 339 Hillside Ave., Jamaica, N. Y. The invention relates to a carrying frame at the rear of an automobile for supporting a pair of spare tires and their rims. An object is to provide means whereby the tires can be quickly and easily clamped in the frame or removed therefrom, with means for locking the clamping part against movement so as to prevent theft of the tires.

ADJUSTABLE JOINT.—W. H. Bovard, 1616 Waterloo St., Los Angeles, Calif. The inventor has been granted two patents of a similar nature which have particular reference to a joint to be used for securing the bumper of a motor vehicle to the frame of the same. The frame usually curves downward where it engages the vehicle spring and the curves vary with the different makes of vehicles, the frames also vary in cross section, and it is the object of these inventions to provide a suitable joint between the bracket holding the bumper and the frame member that may be used for practically any motor vehicle and may be easily adjusted so as to maintain the bumper in its proper position.

WHEEL LOCK.—J. B. Johns, 905 Dana Ave., E., Warren, Ohio. The aim of this invention is primarily to provide a locking device adapted to be associated with steering wheel such as is utilized with motor vehicles. Another object is to provide a device in the nature of a permutation lock, so that a person authorized to actuate the wheel will not find it necessary to employ a key, the lock being simple yet so constructed that it will be impossible for an unauthorized person to actuate the wheel.

RETAINING DEVICE FOR RECEPTACLE CAPS.—C. A. Haas, 81 [illegible], Elmhurst, N. Y. An object of the invention is to provide an economically manufactured, simple and efficient [illegible] receptacles such as automobile tanks [illegible] retained in close association with the receptacles when they are removed to fill the tank and thereby not very easily lost. The device comprises a chain connected from the head of the closure cap to a spring retaining member.

EXTENSION LEVER.—W. F. B. Fries, 887 11th Ave., Paterson, N. J. The object of this invention is to provide a lever extension which may be applied to any suitable type of lever, but which is particularly adapted for use with levers having a hand release, such as the emergency brake lever of the Ford car, and by means of which an operator may retract the lever from its normal position, by means of the extension, and by means of which the release also may be operated through the extension.

AUTOMOBILE TIRE RACK.—C. F. Hull, Hagerstown, Md. One of the foremost objects of this invention is to provide a comparatively light yet strong rack on which automobile tires may be hung, for storage or display, by means of hangers especially constructed for the purpose, means being embodied in the rack for simultaneously locking all the hangers in place to prevent the unauthorized removal of any of the tires.

STABILIZING AND ALINING DEVICE.—C. R. Lumley, New Castle, Wash. This invention relates to alining devices especially adapted for use with the steering mechanism of motor vehicles. The object is to provide a device of this character which intercepts, absorbs and opposes road shocks and vibrations, eliminates back-lash and causes the vehicle to maintain a true course over rough roads and around sharp curves.

SHOCK ABSORBER.—F. A. Dowler, 1727 San Antonio Ave., Alameda, Calif. The primary object of the invention is to provide a shock absorber which is adapted to be associated with the spring structure of vehicles such as automobiles for absorbing and diminishing shocks and vibrations incident to the irregularities of the road surface. In this device air is employed as a cushioning medium.

FRONT DRIVE FOR MOTOR VEHICLES.—M. G. McNeely, Tulare, Calif. The invention has particular reference to a combination driving and steering device. The principal object is to provide a suitable connection between the front axle of a motor vehicle and the wheels, allowing the latter to be driven by the front axle and at the same time allowing the pivotal motion of the wheels on the axle whereby the motor vehicle may be steered.

VALVE.—W. S. Penfield, 141 Beaver St., San Francisco, Calif. The invention relates to a valve which is especially adapted for controlling the discharge of gasoline from the tanks of motor tank trucks such as are used in supplying gasoline service stations. The primary object is to provide a valve which will be quick in action and provide for an expeditious discharge and filling action, which will be leak-proof and easy to operate, and in which damaged or worn parts may be readily renewed.

NON PNEUMATIC TIRE.—C. A. Fisk, 656 Southern Blvd., Bronx, N. Y. The principal object of the invention is to produce a substitute for pneumatic tires, and to provide a filler element for disposal within the outer shoe of a tire which replaces the usual inflated inner tube, functions to give the required resiliency and at the same time eliminates the trouble incident to inflated tires by precluding punctures and blow-outs.

Designs

DESIGN FOR LEATHER OR SIMILAR ARTICLE OF MANUFACTURE.—F. A. Koch, c/o [illegible] & Brightman, 21 Spruce St., New York, N. Y.

DESIGN FOR A STREET SIGNAL LAMP.—F. Mizzarro, c/o [illegible] Mfg. Co., John and William Sts., New York, N. Y.

DESIGN FOR A STORE FRONT.—M. [illegible], c/o [illegible], 116 Duane St., New York, N. Y.

DESIGN FOR A [illegible].—H. E. [illegible], [illegible] Ave. and 15th St., New York, N. Y.

DESIGN FOR [illegible].—C. E. [illegible], c/o [illegible], [illegible] Ave., New York, N. Y.

DESIGN FOR [illegible].—[illegible], [illegible] St., New York, N. Y.

DESIGN FOR A [illegible].—[illegible]

Study of Material and Methods Needed in Non-Metallic Gear Production

Quiet gear-driven front end obtained. Tests with a typical product indicate blanks are more expensive than metallic type. Fewer tear-downs and easier inspection offset extra cost. Analysis of manufacturing processes improves results

By J. Edward Schipper

Reprinted from Automotive Industries May 17, 1923.

A QUIETER front end drive at little or no increase in cost as compared with metallic gears can be obtained by the use of certain non-metallic materials, provided proper precautions are taken in the processes of manufacture. Blanks for non-metallic gears are more expensive than those for metallic, but the difference in the cost of the blanks is offset by a reduction in the number of rejections for noisy operation, and, consequently, of the tear-down and rebuilding operations. However, the material can be used to best advantage only if the manufacturer first acquires an intimate knowledge of its properties and of the best methods of handling it.

Where gear drive is used for the front end, the problem of silent operation will probably first be attacked by the manufacturer from the standpoint of improving his metallic gears. In analysing his problem, he will invariably find that the difficulties are, first, the high cost of obtaining extreme accuracy in gear manufacture, and, second, the resonance of the material itself.

The expense of machining metallic gears to extreme accuracy logically leads to a study of non-metallic materials, with which quietness can be secured without going to the extreme in low tolerance limits. Recently there has been considerable discussion of the possibilities of grinding front end gears to obtain accuracy. Owing to the limitations of gear grinding machinery up to this time, this, of course, would involve a return to the spur type of gear, a rather drastic step. Developments along this line would be of great interest.

The Formica Insulation Co., manufacturer of non-metallic gear blanks, has made an interesting study of just what can be accomplished with non-metallic material. This concern has more than 800,000 engine timing gears now in service. It maintains that the fundamental requirement made of gear material is that not only must it be able to withstand the stress set up by normal loads, but also to take care of overload and shock stresses.

Metal gears fulfill this requirement, but it is difficult to keep them uniformly quiet, because slight inaccuracies are likely to occur in their manufacture. The metal is not elastic enough to compensate for these inaccuracies when the gear is in operation, and the "ring" of metal striking metal at high speeds forms an undesirable noise. Variations in the clearance between gears caused by whip of a shaft at high speed and by a slight change of centers due to heat expansion accentuate this action.

Non-metallic material should have the required strength, should be oil and heat resisting, and, in addition, be more elastic and non-resonant. For the same degree of inaccuracy, the non-metallic gear would be quieter, because the vibrations set up by the tooth hammer due to the inaccuracy of the gear form would be of less amplitude.

It must be conceded that some of the early non-metallic material promised much in experimental work but fell down in service. There has been a great deal of development since that time, with the result that it is now possible to secure products having the required uniformity and endurance.

As the material is non-resonant and is adequate in strength, the entire matter centers about the knowledge of how to manufacture the gears. One manufacturer who has used non-metallic material for years gives the following rules for the production of the gears:

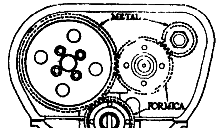
"Take all precautions you would take in cutting a good set of metallic timing gears. Spend plenty of time studying the substance of your non-metallic gear blanks. Learn by experiment its behavior on the gear cutting machine as well as when installed in the timing gear train."

This manufacturer states that attempts to solve the non-metallic gear cutting problem will fail if the utmost pains are not taken. Without a knowledge of the physical characteristics of the blanks, there will be spells of noisy gears and no solution except the very inefficient and costly one of changing timing gears on almost finished engines.

As the opinion of this manufacturer seems to agree with that of most others who have offered their views on this important subject, a further exposition of the points made by him will be of interest. It is necessary to have good machines, in perfect alignment, true running arbors, etc., on which to cut or hob the gears. He advises the cutting of one gear at a time rather than the "ganging" of blanks on an arbor. It is necessary to keep the hobs sharp.

In cutting non-metallic gears, the blanks must be backed up so as to avoid breaking out teeth. As far as speeds and feeds are concerned, most of the non-metallic materials can be handled like brass. Some materials are cut dry, Formica being one of these.

Another manufacturer who has found that non-metallic gears are entirely satisfactory as far as wearing qualities and silence are concerned, states that lapping compound of any kind should not be used in running in the cast-iron gear with a master gear. The abrasive in the lapping compound imbeds itself in the gear and very shortly cuts away the teeth of the non-metallic gear. This manufacturer further states that he suspects that this practice has contributed to any lack of success with non-metallic gears.



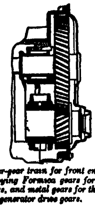


Fig. 2 — Four-gear train for front end drive on Reo engine, employing Formica gears for the crankshaft and idler gears, and metal gears for the camshaft and generator drive gears.

Fig. 1 — Two gear train on the Maxwell motor using a Formica pinion on the crankshaft against a metal camshaft gear

Tolerances for Formica Gears

It is, however, a fact that Formica gears, as used in the front end drive on this particular car in both four and six-cylinder types, have proved satisfactory to the manufacturer. This concern fits the gears with approximately the same backlash as used with metal gears. The timing train on this car has only two gears, the generator and fan assembly being driven from a pulley mounted on the crankshaft extension. The water pump is mounted and driven at the forward end of the camshaft. No inertia forces of any magnitude are imposed on this front end drive.

Most of the manufacturers using gears of Formica or a similar compound have found that more liberal tolerances for backlash are possible. The shaft centers, however, must be held quite close. One concern cuts the Formica gears to have about 0.003 in. backlash. If the tooth form and helix are held within narrow limits, the results have proved very satisfactory. If not accurate, the gears wear out rapidly, and nearly every case of undue deterioration has been chargeable to improper tooth form or error in the angle of the teeth.

In manufacturing timing gears from non-metallic substances, it is necessary to check the finished product very closely while setting up the tools, as the material has a slight tendency to spring away from the cutter in machining. The Maxwell Motor Corp. has found that the same limits can be held as on metallic gears. When this is done a quiet front end is possible with negligible selection in assembly.

One of the points which is discussed probably more than any other in connection with the use of non-metallic materials for front end drives, is whether the large camshaft gear or the smaller crankshaft and generator gears should be made of composition. For a long time it was believed that the camshaft gear should be non-metallic, but manufacturers of non-metallic gear materials now have become convinced that it is better to make the two smaller gears non-metallic. The reason advanced for this is that the teeth of the crankshaft and generator gears wear only at the point of meshing with the camshaft gear, whereas the camshaft gear wears at two points, where the crankshaft gear meshes with the camshaft gear and where the generator gear meshes with the camshaft gear. Furthermore, there is an uneven wearing action upon the camshaft gear. At one point it is being driven by the crankshaft gear and at another it is driving the generator gear. Hence, the fact that the camshaft gear has twice the number of teeth is more than offset by the double and uneven wear explained above.

Uniformity in Manufacture Stressed

In some cases the composition camshaft gear is at a disadvantage for several reasons. It is quite apparent, for instance, that the strength factors with this type of material decrease very rapidly with increased diameter. Consequently, the smaller gears are far stronger than the larger camshaft gears would be. Furthermore, the cost of the gear blank rises rapidly with increased diameter and, taking account of these various factors, it will be seen that a more durable and lower priced installation results if the two smaller gears are made of non-metallic material, rather than the larger camshaft gear.

The development of Formica material has progressed over a number of years, and the method of manufacture is of interest. The big problem is to secure not only the necessary physical properties, but also a high degree of uniformity. Formica is manufactured from a specially woven cotton duck and Redmanol resin, the latter being the anhydrous product of the Bakelite Corp. A feature of the duck employed is that it possesses the same strength in the warp and in the weave, with the result that the finished material has the same tensile strength both with and across the grain.

The cotton duck, in the form of a continuous web, is subjected to an impregnation process comprising two steps and which is claimed to insure the complete impregnation of every fiber of cotton with the resin. After impregnation, the treated duck is passed through a steam-heated oven, the speed of passage, circulation of air and temperature being automatically controlled. The passage through this steam-heated oven starts the reaction in the phenol resin, and drives off all volatile materials, including whatever moisture there may be in the duck itself.

After this treatment, the duck is cut into sheets of the proper size, the individual laminations are built up to the desired thickness and subjected to the final curing process in steam heated hydraulic presses, where a pressure of nearly one ton per square inch is applied. The material is cured at a temperature of about 175 deg. C. The time of curing varies with the thickness of the sheets being manufactured.

The final curing completes the reaction in the phenolic resin and renders the product practically infusible and insoluble in water, oil or any of the ordinary solvents. The material is removed from the presses in the form of sheets, and from these sheets the blanks are cut, either by band sawing or circular cutters. The material is then subjected to critical inspection with regard to hardness, insolubility, tensile strength, moisture absorption, etc.

The final product has a tensile strength of about 10,000 lbs. per sq. in., a modulus of elasticity of 320,000 lbs. per sq. in., a Brinell hardness of 34, a specific gravity of 1.38, and a coefficient of linear expansion of 0.00002 per deg. Fahr.

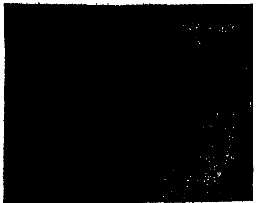


Fig. [illegible] — A [illegible] gear train with cast-iron camshaft gear and [illegible] crankshaft and generator gears used on engine for Lexington cars.

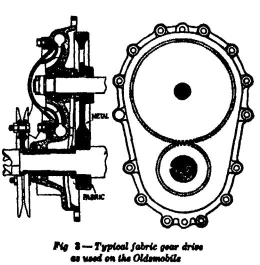


Fig. 3 — Typical fabric gear drive as used on the Oldsmobile

Miscellaneous Notes

16,500,000 Books Printed.—Basing conclusions on what is considered reliable data, an English librarian estimates that since the invention of printing in Europe in the fifteenth century the output of the world's book presses has amounted to about 16,500,000 titles, of which some 4,400,000 have been printed since 1900. The librarian believes that perhaps 20,000 of all the books printed still possesses value.

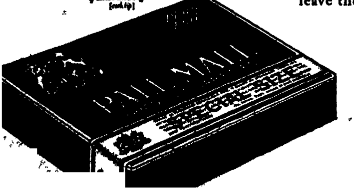
No Girl Engineers Need Apply.—An English steamer recently shipped a woman engineer. This was a concession made by the powerful union to enable her to complete 18 months at sea so as to become a fully certified engineer. Work in an engine room especially on a smaller type of steamer is very hard and seems beyond women's strength. It is not likely that the experiment will be repeated, shipping men think.

An Electric Fashion.—To keep up with the fashion a woman must change her handbag pretty often. The latest is an illuminated one. When the bag is opened a tiny electric bulb is immediately switched on, showing the interior, and allowing the owner instantly to find keys, money, theater or railway tickets, or to use the little mirror which is one of the fittings. Thus is woman saved from hunting in her bag in the darkened theater or taxi.

Ocean-Current Investigations.—In connection with its studies of the distribution and movements of larval fishes and other pelagic marine organisms, the Bureau of Fisheries has undertaken investigations of ocean currents of the north Atlantic coast and for that purpose has deposited about 1500 drift bottles. These have been dropped on three lines, running respectively, for a distance about 75 miles off Cape Elizabeth, 150 miles seaward from Chatham, Mass., and 150 miles seaward from Sandy Hook. The stations are at intervals of about one-half mile, two bottles being dropped at each, with drags at different depths, the bottles being weighted so as to float with but a small part of the neck exposed. Each bottle contains a card offering a reward of 25 cents if sent to the Bureau of Fisheries with information concerning the date and location at which it was found. Upwards of 200 of these cards have been received already

Cheaper Sleeping Cars in France.—Sleeping cars on the continent are something to be indulged in only after counting the cost, but drastic reductions in rate must be made if the traffic is to be restored to normal volume. France is leading the way by introducing second and third class "couchette" cars. The first class rates have been outrageous. With the new cars, one can travel in a second class "couchette" for less than the straight first class fare, and in a third class "couchette" for less than a straight second class fare. The price for 250 kilometers (156 miles) in the second class is 16 francs and 65 centimes, and in the third class 11 francs and 60 centimes, both in addition to the railroad fare. Couchette compartments are constructed with six potential bunks. These comprise seats—the back of the seats raised in a horizontal position—and a new type of hat rack, broad and strong enough to hold a sleeper comfortably. The innovation is a great boon to those in moderate circumstances, as a great amount of long distance traveling is done by the middle class and tourists at night.

A Postal Improvement.—Another time and labor-saving device for use in expediting the mails has passed the experimental stage and is being tested by the Post Office Department. The device will pre-cancel stamps put up in coils for use on other than first class mail by large mailers, before the stamps have been affixed, and will then recoil them in the original sized coil. Heretofore many large users of such mail have purchased uncanceled stamps in coils which were then placed on outgoing mail by stamp-affixing machines already in general use, necessitating the running of such mail through the canceling machines at the post office. With the new device in operation, however, the stamps would be purchased already canceled. The mail with the canceled stamps affixed would then be sorted and tied in bundles by the mailer according to destinations and sent to the post office where it would go to the trains, leaving the canceling machines at the post office free for other work. The new device is called a pre-canceling machine. Various types have been developed by a number of manufacturers to a point which the Department believes warrants giving them a try-out.


PALL MALL

Science Notes

A Large Telescope for Argentina.—A 60 inch reflector has recently been completed by a Cleveland optical works for the Argentine National Observatory The mechanical equipment is unusually accurate and the entire instrument is a credit to the optical skill of great firm of builders of machine tools.

Diminishing Death Rate—The death rate of 1922 was the lowest of any year excepting one in the history of the United States and Canada, according to the statistics of the Metropolitan Life Insurance Company The rate was 8 8 persons in each 1000 in 1922 while in 1921 the rate was 8 7 persons

A "Nutrition" and Intelligence Quotient Slide Rule.—Dr Thomas D Wood has designed a new slide rule to simplify the nutrition" calculations in which deviations from average weights of children are expressed in terms of percentages of such averages The slide rule has great terrors for the uninitiated but when once mastered is a great time saver

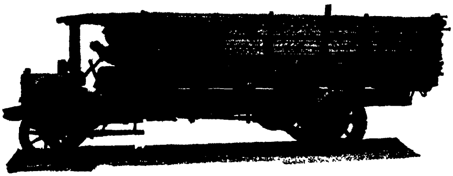
An Italian Fresh-Water Laboratory.—Lake Trasimeno on the road to Rome from Perugia, is of great historical importance, as it was here that Hannibal gained a sanguinary battle in 217 B C The lake abounds with fish so that it is admirably adapted for biological researches. The lake is 31 miles in circumference and the altitude is 850 feet The new laboratory will be attended by students from several foreign countries.

Another Mean Thief.—Sometime ago we called attention to the mean thief who stole platinum from the terminals of the lightning rods of Notre Dame in Paris and now we have a meaner thief or thieves. Germany's most important earthquake observatory at Koenigsberg was put out of commission when all the bronze parts of the seismograph were stolen Situated on the Baltic-Russian Plateau the observatory enjoyed a unique position for earthquake investigations.

Wren's Science Museum.—During the recent Wren celebration interest was focussed on St Paul's and the beautiful London churches designed by him but attention should be called to the fact that he designed the Old Ashmolean Museum at Oxford This was the first public museum of natural history and was only a few yards away from the famous Sheldonian Theater an earlier work of Wren The original meetings of the Royal Society of which Sir Christopher Wren was at one time the president, were also held here.

A Voice with Five Octaves.—At a recent meeting of the Austrian Society of Experimental Phonetics in Vienna Dr Réthi presented Michael Prita age 44 years, whose voice possesses the remarkable range of five complete octaves The deepest note uttered by this singer was a bass F corresponding to 4 vibrations per second and two octaves lower therefore than the deepest note which can be produced on the violin The only previous record of so low a tone in the human voice was that of a bass singer named Fischer who lived in the early part of the 18th century Prita also rendered upper C with its full artistic value Beyond that the notes passed into the head register and into a falsetto resembling a soprano says *The English Mechanic* The highest notes emitted were the upper F (demi-semiquaver) and on exceptional occasions upper A demi-semi-quaver) corresponding to 1740 vibrations per second which is one note higher than the highest sung by Patti.

Windowless Museum.—Dr F A. Lucas, Director of the American Museum of Natural History thinks that the museums of the future may be dependent upon artificial light entirely at least for certain classes of exhibits. Dr Lucas describes a series of tests made by Sir Sidney Harmer Director of the British Museum of Natural History, wherein objects were exposed to different kinds of light continuously for nearly three years Of these tests Dr Lucas says "They show conclusively that electric light is much less harmful than daylight and Sir Sidney writes A gallery without windows, lighted entirely by electricity preferably not arc lights, would have great advantages. " The failure to produce a transparent non-actinic glass capable of filtering out the destructive elements from sunlight, says Dr Lucas, means that museum authorities must turn to electric light for the solution of the problem. It is estimated that the gain in wall space from the omission of windows would offset the cost of electric light. It also would [illegible]



—yet their cost is very low

Kelly Kats are massive single-cushion tires especially designed for heavy- and medium-duty trucks.

They have all the sturdiness of solid rubber tires and can stand punishment even better, yet because of their distinctive construction they are able to do many things which solid tires cannot do.

They get traction without chains on almost any kind or condition of road and cushion a truck practically as well as properly inflated pneumatics.

They offer many advantages over pneumatics because they are more dependable, far longer lived and cost a great deal less.

Whether a truck owner buys tires for the service they give or for the money they save, Kelly Kats will satisfy him.

There are no Caterpillar tires but Kelly Kats

KELLY-SPRINGFIELD TIRE COMPANY

250 West 57th Street New York

KELLY KATS

THE TIRES WITH NINE LIVES

Electrical Notes

Invisible Bell Wiring is a recent British contribution to the electrical field. It consists of two flat copper strips securely held between two paper tapes, which can be easily installed by glue, paste, or cement. The invisible bell wire can be fixed on walls under wall paper, on ceilings under whitewash, or on floors under carpet or linoleum. When run on the surface it can be painted or colored to match its surroundings and is then perfectly invisible.

Loud-Speaker Voice for Operating Room.—An unusual application of loud-speaking equipment is reported in *Radio Electricité*, in connection with the operating room of a French hospital It appears that above the operating room in question there is a glass roof through which the operations being performed by the surgeon may be followed by medical students. The surgeon, while performing the operation, talks into a microphone in the operating room, and the current is amplified through ten vacuum tubes, for delivery to a battery of loud-speakers in the observation room above. In this manner the medical students not only see what is being done in the operating room, but they receive the explanations from the surgeon at the same time

Transmission at 220,000 Volts is now an accomplished fact. According to *Electrical World*, the switches on the Big Creek lines of the Southern California Edison Company were closed and 220,000 volt transmission became an accomplished fact. The event marks the culmination of years of research, experiment and study of the problems of higher voltage transmission by some of the most prominent electrical engineers in the profession. The Big Creek power lines had been operating for some time at 150,000 volts. Before being changed over to 220,000 volt operation additional insulation units were added, making a total of eleven units on suspension and thirteen on dead ends. Each line has a capacity of 125,000 kilowatts at 220,000 volts.

Men Who Made Your Telephone is the title of an attractive advertisement which recently made its appearance in connection with an educational advertising campaign of a leading electrical manufactory We learn that we are thankful to many races for our present telephone instruments. The British Indian is the swarthy miner of mica—the insulation inside the telephone. The Japanese prepares the silk used in the covering of the telephone cord. The Russian mines the noble metal, platinum, used for contact points. The Egyptian is responsible for certain cottons used in insulation, which originate in the Nile Valley The Brazilian drains rubber from a tree, and it is this rubber which forms the case of the receiver The Irishman raises flax, from which is made linen paper, used in the telephone condenser The Pennsylvanian coil miner contributes the grains of coal used inside the transmitter—the vocal cords of the telephone, in truth. The Alaskan digs such gold as is used in the telephone. Finally, we have the American workman who, from a slub of rubber, a bundle of vegetable and animal fibers and a curious medley of minerals brought from every corner of the world, produces a marvel of precision and ruggedness—your telephone.

Beetles Which Bore Through Lead Cable, but which, nevertheless, do not or cannot penetrate pure gum rubber, have proved a serious problem and pest in California and many other parts of the United States. One of the most important injuries inflicted by these beetles is the damage done to the lead sheathing of telephone cables in California. The beetles bore circular holes in the sheathing, about one-tenth inch in diameter Moisture enters the cable through these holes, causing a short-circuiting of the wires and interruption of service to the public. As one hole may put from 50 to 600 or more telephones out of use for from one to ten days, the damage is rather extensive. From experiments undertaken by the Bureau of Entomology of the United States Department of Agriculture, it has been learned that the beetle is able to penetrate any lead alloy used as a cable sheathing or any poison or repellant placed on it. Probably it is able to penetrate the poisons because it does not feed as it bores through. Beef tallow, when sufficiently soft, will stick to the beetle and suffocate it, and has been used with some success on the rings which suspend the cable, since practically all the boring is done near the rings. Layers of friction tape impede the boring, and thin sheets of copper, zinc and steel prevent it.

Invention and the "Grifter"

(*Continued from page 79*)

slightest hint of unusual familiarity And then, turning to the crowd:

"These four ducks belong to the gentleman there. Please remember they are reserved! Not to be played foah! Anything else is yours, my friends! Step right up and win the fresh unkilled poultry!

The Huckery Buck game is gimmicked in a very simple manner Buried in the earth under the kegs or buckets are a number of stiff wires which lead to taps, plungers or buttons in several parts of the grifter's lair These control the false bottoms of the various receptacles. If a friend strolls by the grifter neglects to touch or step on any of these controls and the spring bottom does not rise Naturally, the friend wins. But let the sucker come by with his money and instantly the grifter steps on a control and there is no winning. The ball hits the springed bottom and out it pops.

Whoever has attended a street fair remembers the various prize wheels or "spindles" as they are called by the park and carnival trade. They are all, in some sense, imitations of the roulette wheel. In the good old days they were spun for money prizes. Today they usually 'roll" for dolls or candy or blankets or near-Chinese vases.

I regret to say that the vast majority of these wheels are gouged (the grifter term for fixed, when applied to a wheel) in various and clever ways. Some are magnetically or electrically controlled. At the moment when the number winning the valuable prize has just passed the needle, the grifter leans against his table, thus connecting a switch and causing the wheel to dwindle to a stop before it can circle back to the winning number Others are mechanically stopped at the wrong place, by use of a brake either upon the rim of the wheel or upon the axle of the spindle.

Before I go too far along this line, however, let me record an encouraging fact. The games played in summer parks and along boardwalks are gradually verging toward commercial honesty Perhaps 50 per cent of all games now permitted are what the grifter calls "percentage rackets." By that he means that the operator of the booth gets a high price or 'percentage" but does no fixing or gimmicking

For instance, in every park and on every boardwalk today are various race horse, balloon inflating, automobile racing and similar mechanisms. Upon a mechanical board are the balloons, horses or motors before the player is a circular disk which he rotates. This turned wheel controls the movements of a certain balloon, horse or car There are usually from ten to twenty such mechanical controls for players. Each player pays ten or fifteen cents. Thus a ten-wheel game, at fifteen cents a place, was operated all last summer, in a resort where I was stopping, for prizes of fancy basketware. Every time the grifter started his mechanism he took in a dollar and a half and gave out an ornate basket whose wholesale price was and is less than fifty cents.

But, remember, it's summer, the crowd is sunstruck or moonmad The pleasure of gambling for something is worth all the difference in value And there is a peculiar public psychology about the whole thing A woman friend had her heart set on a rather fine looking piece of Japanese monochrome china in a booth at Atlantic City last winter She went day after day and played the rollball game of which it was the highest prize On a Saturday evening she came by after she had been playing for months and keeping her score in the oriental grifter's book, played a few extra games and finally accumulated enough points to take home the prize How much did it cost her?

"Well, I just rolled six times tonight," she said exuberantly, "sixty cents!"

By consulting with the friendly Japanese and his score book, I found the vase had actually cost her seventy three dollars. Its retail value was not more than ten

But though these percentage games grow in favor, the old tricks survive and the public seems to give them unwavering affection There is the strength testing sledge machine. You strike a plunger and shoot a weight up a wire line to ring a gong at the top of a tall beam. The number of pounds of supposed pressure are registered on the sides of the upright column. All day long some lusty looking shillaber stands there and sends the weight to the top at every blow of his mallet. But when you step up—ah the difference! The grifter has simply touched a little control which warps the track-wire

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Our Psychic Investigation in Europe—IV

(Continued from page 86)

broken through accidental convulsion on the part of the medium as might easily happen, a claim to this effect could have been advanced at the time or at the end of the seance. In merely putting forward the suggestion that here is the weak spot of this sitting I am not bound to account in detail for how all the phenomena might have been done fraudulently

The thread was supposed to remain intact, and importance was attached to its remaining intact, and questionable means were employed of enabling me to judge whether it did so remain and as a consequence I am unable to assert that it did This does not by any means damn the seance or its results, but it does constitute a pertinent fact.

Well with the medium secured as described the circle was formed and we were instructed to join hands all around save that the medium's hands were not included There was thus a break in the circle at the point where the medium sat I was at the medium's right and the clergyman at his left and assuming that no two people sitting side by side were confederates, all hands were accounted for save my left and the Reverend's right. The seating seemed to be quite casual and I did not feel that there was confederacy In any event, none of the sitters from the Sunday seance at Crowborough was there save Sir Arthur himself and the minister and I really think we shall have to acquit them

The medium cautioned us not to leap up, cry out or break the circle of hands under any circumstances and not to sit with crossed legs. All this of course, could equally be in the interest of a proper psychic circuit, or with the intent of making the location of all the sitters by a fraudulent operator more certain The latter explanation was rather discounted when the medium told us that if we thought at any time we heard or felt him moving about the circle we might lash out and kick about with our feet to our heart's content—just so we did not break hands or sit with legs crossed He then had me place my left foot upon his right, and vice versa in the case of the clergyman at his other side His foot could be distinguished from that of any other sitter by his soft felt shoe my foot remained on his throughout the sitting without withdrawal or substitution and the clergyman testified to the same effect.

The cabinet was in use The curtains were drawn at the front and inside there stood a round top table perhaps two feet in diameter with four legs On this table were two clusters of sleighbells a trumpet and a vase of cut flowers, in water The minister by virtue of the lop sided effect given the circle through tying the medium to one of the cabinet pillars was squarely in front of the curtains. He was cautioned not to be alarmed when they opened and blew cold winds across him or when objects were dragged out of the cabinet past him

The lights went out and the medium went quickly into trance to the singing of hymns without music. Black Hawk came quickly speaking in a thin piping voice, which soon got deeper, displaying then no peculiarity other than unfamiliarity with English His command of the language was good, only his articulation was weak.

A little vocal work was done here and there during the seance, but only two communications deserve notice A very recently deceased parishioner of the Reverend came in and asked the Reverend to do something about sending a letter to the decedent's son in Liverpool The Reverend stated that there were highly evidential details here, and promised to do what was asked of him.

Later a person calling himself Wallie spoke loudly in my ear with great confidence, and was highly scandalized when I did not claim him at once. "My God man, you don't mean to say you don't remember me!" To my best judgment nobody of the name whom I ever knew is dead and certainly I never knew a Wallie as intimately as this reproof would assume. He added that he was "Wallie, from the office of the paper"—which was significant in view of the fact that none present save Sir Arthur was supposed to know my professional identity; but even so I wasn't able to identify him, and he left in a huff.

A few other attempts at communication were of no interest; the seance as a whole was of a distinctly physical character

The first manifestation again, from the

(Continued on page 15[illegible])

Mechanical Engineering Notes

Silicon Steel for Bridges.—According to an article in *Iron Age*, silicon steel has entered into the construction of a number of bridges, and is to be an important factor in the new Delaware River Bridge at Philadelphia.

Making Metal Bottle Caps.—The final operations in the manufacture of jar caps, salve and pill boxes, bottle caps and similar articles, such as threading, knurling, beading, curling and trimming are performed by rolling, using an automatic machine.

The Scarcity of Coal since the French invasion of the Ruhr Valley has set the Germans to thinking of ways to use the force of the tides for power. The chief difficulty seems to be that the north coast of Germany is very flat, and consequently that the available head of water is too low for practical use.

Cylindrical Nuts.—A contributor to the *American Machinist* advocates the use of cylindrical nuts. They may be put on and removed with an alligator wrench and are easily made of crop ends of shaftings, and of rods and bars. They may be sawed off, or cut in the lathe with a parting tool and crowned at the same time. When used on machinery they are more easily kept clean than prismatic nuts. Finally, they have a larger footing than hexagon nuts.

Combined Impulse and Reaction Turbines are smaller and require less material than solely reaction type turbines, according to *Power*. In the former, steam is expanded from a nozzle and then passed through two rows of revolving blades. The steam from this point is expanded in a long series of reaction blades, where some expansion takes place in each row. The impulse stage has fewer blades and takes up less room than a corresponding staging of the reaction type.

A Metric System Compromise.—The advocates of the metric system, having failed so far to introduce the system into the English-speaking nations, have turned their guns in another direction and are trying to bring about a change in the value of the pound weight, in order to give it simpler relations with the metric system. This would be accomplished by assuming that a pound has a weight of 500 grams, instead of 454. If this could be accomplished without upsetting civilization, the result would be of great value. But the 454-gram pound goes marching on.

A Radical Departure from ordinary practice has been made on the Detroit, Toledo and Ironton Railroad in that the hand rails of the locomotives, as well as cylindrical heads, steamchest covers and locomotive numbers are nickelplated. The *American Machinist* further describes the changes made, among which are the equipment of all engines with folding repair kits, electric trouble-spotting lights, and a chair for the engineer. It was believed that better care will be taken of the engines if their appearance is made more attractive. The D. T. & I. R. R. is the property of Mr. Henry Ford.

Sectional Dies are used extensively in the production of armature laminations for electric motors and generators, according to *Machinery*, and are also applicable to the manufacture of other classes of stampings containing a large number of perforations. The only essential difference in design between the sectional lamination die and the solid die is that the punch holes in the sectional die are formed by sections arranged radially and accurately fitted and assembled on a plate. These assembled sections form the lower die member, the punches, also assembled on a plate, are aligned with the lower die, as in sub-press construction.

Exhaust Gases from Diesel Engines.—In the opinion of one writer on marine subjects, the most economical way of utilising the exhaust gases from slow-speed Diesel engines is to lead them through a steam boiler and generate steam to be used in a steam engine, either reciprocating or turbine type, with a condenser. He advocates the use of a reciprocating steam engine rather than a combined Diesel-steam as in the Still engine. He comes to the conclusion that by installing an effective steam boiler with superheater, feed water heater, etc., utilising the exhaust heat of the engines and generating steam, connecting this to a turbo-electric set which delivers power to a motor direct-coupled to the main engine, the power can be increased by about 120 horsepower for every 1000 brake horsepower of the main engine.

Radio Notes

Loop Antenna for Receiving.—One of the good effects of the new broadcasting movement has been to bring to attention the great interference problems which exist The loop antenna has been brought into great prominence for receiving purposes, as a means available for avoiding interference Practically unlimited receiving ranges are possible with the loop when sufficient radio frequency amplification is used One reads frequently in the various radio periodicals of the great distances obtained on loops even as small as two feet in diameter In solving the Naval problems it is more than probable that the loop can be of service other than its present narrow use for direction finding It is even conceivable state Naval authorities, that all receiving may be done on loops sometime in the near future Some of the advantages claimed for the loop are (a) Sharp tuning (b) Wide range of frequencies available in a single coil (c) One tuning adjustment (d) Directive effect. (e) Easy portability and replacement. (f) Small space occupied and (g) Very much less reradiative effect when regeneration is used

Improved Loop Aerial System.—A receiving tube when directly connected across the tuning condenser of a loop aerial has a voltage impressed on it in two ways (1) The coil circuit is in tune with the incoming wave and (2) the coil acts as a capacity area one end being at or nearer earth potential since the filament battery is connected to one end of the coil and the small grid to the other thus giving through the battery a relatively large capacity to earth as compared with the very slight capacity to earth through the small grid recently wrote F W Dunmore in *Wireless Age* The voltage induced in the second way is detrimental as its amplitude is constant regardless of the position of the coil with respect to the approaching wave To avoid this difficulty an iron core coupling coil is used The primary of this is wound in several sections and its ends are connected to the tuning condenser terminals The secondary is interleaved with the primary and is connected to grid and filament battery From the latter a connection is made to the rotating vane of a small balancing condenser whose two plates are connected to the tuning condenser terminals If necessary the iron core can also be connected to the same filament battery terminal by a switch It is claimed that this arrangement distributes the capacity effect more evenly to earth and serves partially to by pass to earth through the iron core disturbing influences such as motor noises.

The "Leviathan's" Radio Set.—Eclipsed only in importance by her powerful machinery and delicate controls the radio installation aboard the Leviathan which reenters the trans Atlantic service some time in June flying the U S Lines flag will be the most powerful and elaborate steamship radio equipment in the world The radio equipment of this huge ship will enable her passengers to exchange messages with two continents regardless of her position on the high seas. With equipment six times as powerful as that carried by the average ocean greyhound uninterrupted communication with points 3000 miles distant is assured Upon leaving her berth in New York harbor the Leviathan's radio officers will be able to link the ship with various marine centers in Europe and vice versa to communicate with America when leaving European ports In addition to telegraph service, a radio telephone installation which will provide voice contact with other vessels and shore stations is also to be installed While it is not expected that a commercial telephone service will be inaugurated immediately on the "Leviathan's" going into commission, it is quite probable that shore stations will in the not distant future be erected to handle wireless telephone traffic from ships in mid ocean to points inland over the conventional land line systems. The principal radio telegraph transmitter to be used consists of a high power vacuum tube outfit which will deliver to the main aerial about six times as much power as the apparatus now used on the average steamship. The second transmitter is a duplex telephone outfit which will permit simultaneous telephone and continuous wave telegraph communication. The third or emergency sending equipment is a standard spark set which will normally operate on 600 meters. Several super-sensitive vacuum tube receivers will be used for reception.

Radio Notes

Radio in China.—The Peking correspondent of *The Times* of London reports a difficult situation with regard to radio which has arisen in China. Two years ago an American company contracted to erect radio stations in China, and it has now landed engineers and material. The government, however, refuses the necessary consent to the starting of the work, on the ground that other powers have protested that the American agreement conflicts with the rights previously acquired by their nationals. The Japanese are mostly concerned under the Mitsui Agreement of 1918, which gave them a radio monopoly for a period of 30 years. The Americans contend that the monopolistic clause of that agreement is contrary to the theory of the "open door" and incompatible with the terms of the Chinese-American Treaty of 1859 Under the Japanese agreement a large radio station has been for several years under construction near Peking, but it is not yet open for traffic owing to technical difficulties.

History Repeats Itself in Great Britain.—We are not alone in our radio experience. It seems as though Great Britain, which is following in our radio broadcasting footsteps, must pass through much the same experiences as we have passed through "There are many reasons why this unfortunate controversy should be settled at the earliest possible moment," states *The Electrician* of London, referring to a broadcasting scramble in which the British radio men now find themselves. But more to the point "And one of the most important of these is that a slump has occurred in the sale of wireless apparatus. This is unfortunate at a time when manufacturers were beginning to get into the swing of the business, but, having all circumstances in view, it can hardly be described as unnatural The paragraphs, columns, and discussions on the subject of broadcasting which have appeared in the daily press during the past few weeks have, to put it mildly, puzzled the public. Those who were about to buy wireless sets are holding off until they can decide for themselves whether to become a listener-in is or is not an illegal act. Even those who have sets are not certain whether they are entitled to use them, and sales are suffering on that score." True, the British broadcasting situation is unfortunate, especially the licensing phase which compels listeners-in to secure a license from the Government, and pay a rather distasteful fee. But to our mind the British radio industry is passing through the same sort of a slump which struck our young radio industry last summer, at a time when manufacturers were just getting into their full stride and the public, because of summer weather, stopped buying

A New Pacific Coast Broadcasting Station is to be erected in Oakland, Calif., by the General Electric Company Work has begun on the buildings, and workmen are already assembling the radio equipment. It is expected that the new station will be in the air within four months. The plans provide for a two-story brick structure On the first floor will be the office of the studio manager, a general correspondence room for artists and quarters for motor-generator sets and storage batteries. There will be two studios on the second floor, the main studio being large enough to accommodate large bodies of musicians such as a band or symphony orchestra, and a smaller studio from which solo numbers and addresses may be broadcast. The use of two studios will make possible continuous broadcasting. Research is now being carried on to determine the reverberating qualities of the ideal studio in order that the proper amount of dampening may be secured in the Oakland studio to assure the maximum musical quality The radio control room will be on the second floor One thousand feet back of the studio building will be the power house and antenna system. The antenna will be multiple-tuned and strung between two steel towers, each 150 feet high and placed 260 feet apart. Beneath the antenna proper will be the counterpoise consisting of a network of wires, 14 feet above the ground, covering an area of 150 by 300 feet. In addition to the power house which will be one story high, there will be a small building for the tuning apparatus and the end of the multiple-tuned antenna. It is probable that an auxiliary studio, connected with the transmitting equipment of the station by telephone lines, will be located in San Francisco.

Our Psychic Investigation in Europe—IV

(Continued from page 136)

sleighbells. The table was to one side of the medium and behind him, and of course, on the other side of the curtain, in the cabinet. I experimented the next day and decided that the probabilities were against the medium's being able to get them without disturbing the minister. First they rang from their stand in the cabinet; then they came out and travelled freely about the room ringing now here and now there, and caressing the faces of the sitters. They journeyed completely about the circle, passed in and out of it at will, went behind it at various points and to various distances and ranged from floor to ceiling. Soon the second set came into action and on several occasions the two sets rang simultaneously in widely separated portions of the room. At the end of the seance one set was found in the lap of my immediate neighbor, the other on the floor at the far side of the circle.

Next on the bill came the flowers. They were taken from their vase and transported about the room. I was first to feel them and I must say the wet ends dragging across my face like a handful of cold clammy fingers gave me a bit of a jump. While I was trying to make them out, they were presented to my neighbor, blossom end to, and thus identified. They went the rounds caressing hands and faces and usually lingering over these caresses and sometimes being specifically presented to the sitter's nose for smelling. At length the bouquet was broken up and blossoms presented to the ladies in whose possession they were found at the end.

The vase with the water in it next went the rounds, each sitter in turn being gently sprayed with the water—"baptised," Black Hawk facetiously had it. The vase was left on the floor beside one of the sitters.

From time to time during the production of these phenomena the Reverend reported that the curtain was billowing out over him and once I even felt it where I sat. Always when this happened the Reverend got the impression of somebody or something passing him into or out of the cabinet. Twice I felt unmistakably the cool wind from the direction of the cabinet. Finally the Reverend announced that the curtains were spread wider than at any time before—and out came the table, high up, clearing the shoulders of the medium and the clergyman. It gyrated back and forth, judging from its contacts with several of the sitters, then settled down a bit. One leg was presented persistently to the Reverend's knee and finally the table came to earth in the center of the circle with a thud. It stayed there and was there when the lights came on, Black Hawk's scorn of collective hallucination being thus vindicated. My best judgment would have been that with his feet under control as described and the rest of his anatomy entirely free it would take some explaining to show how the medium could have juggled the table as it was juggled.

The trumpet did a little touching but nothing to compare with the flowers and the bells. Its big act came with the singing. Without warning while the circle was rendering one of Black Hawk's favorite hymns, my neighbor and I discovered a deep bass voice between our ears doing more than its share of the work. It shifted to a point between two other sitters, and while there alternated between alto and soprano. It came back to me as a deep alto—a near-tenor in fact. It was heard again on the other side as a real tenor. Then it took its stand between me and my neighbor and for some time sang bass and alto on alternate notes. The control referred to this as a double phenomenon, but, surprising as it was, it was not really that.

At several times I was patted, slammed, or pounded on the shoulder with a "materialized hand." At no time did this come to anyone else, which I thought significant, the medium could of course, have done it to me had his right hand been free. At no time, however, did the arm attached to the hand in question touch the back of my chair where it rose between him and me, though more than once it pounded my left shoulder so enthusiastically that my neighbor felt the blow through my right hand which she held.

Toward the end all else was abandoned for psychic lights. The control sent his spirit aides into the cabinet to work up the power and several times he sent them back in disgrace to get built up to better effect. For a while the results were so faint as to be visible only to the person to whom spir-

sented, and his two neighbors Later they got so that everybody could see the same light. Those presented to me advanced until within a few inches of my face, then withdrew These ones were apparently balls but those that passed across the circle as a whole were less defined and could hardly be described as more than luminous patches. A very good range of movement was shown by the later ones, some of which entered the circle (presumably from the cabinet) at the medium's left, to pass completely across and out, while others started within the circle near the floor and went upward apparently to the ceiling

Finally Black Hawk bade us good night we got the lights back and examined the medium's bonds, as related above Curiously enough—it happens with Mr Powell not infrequently they tell me—the medium did not come out of trance at once even after we had freed him He sat there for ten minutes in full light talking to Sir Arthur and others in the personality of Peter Galloway, a spiritist recently deceased He talked to the Reverend in what appeared to be Welsh relapsing into English to say something about bread and cheese The Reverend a complete stranger in the circle explained that there was in his part of the country a hill carrying this curious name supposedly a corruption of an original Welsh designation What the original was however nobody had ever been able to decide and it was inferred that an attempt was being made to tell Mr Galloway then proceeded to prove his Scotch by giving the approved password, It's a braw bricht licht the nicht (It's a fine bright evening) The statement is made that no Welshman speaking in his own identity could possibly meet this test but I thought this very reckless indeed it sounded to me as though any German could meet it and I could most certainly meet it myself Aside from the bread and cheese incident much was said that the hearers accepted as evidential as impossible of coming from other than Mr Galloway as characteristic of his personality etc but it seemed to me that enthusiasm ran off with good judgment in this matter

Another Forward Step in Electrification

(*Continued from page 98*)

phase converters which will convert this single-phase to three phase current for use in the main motors

The main motors six in number will be of the induction type with wound rotors controlled by liquid rheostats in the secondary circuits The use of induction motors provides that ruggedness and simplicity of construction and a dependability of operation which characterise this type of motors and does away with the use of commutators

Power is transmitted through gears and pinions to jackshafts which are connected to the drive wheels by side rods There are six such motors and six jackshafts per locomotive each connected to two driving axles This design enables mounting the motors above the locomotive frame and the use of side rods makes possible the use of the entire weight on drivers for adhesion thus making possible a tractive effort far in excess of that possible with individually driven axles

A feature of the system adopted is its unusual capacity for regenerative braking It has long been recognised that in such an operation as that of the Virginian one of the most serious problems is that of controlling trains while descending steep grades. This will be accomplished in this case wholly by regenerative braking, the air brakes being held entirely in reserve for emergency use By virtue of the type of motors and the system adopted, the capacity of the locomotives for holding on down grades will be in excess of their tractive capacity in climbing

A steam power station with an installed generator capacity of 50 000 kilowatts will be built at a convenient location on the New River, near the middle of the section to be electrified Single phase current will be transmitted at 88 000 volts over twin circuits on steel towers The voltage will be reduced by means of transformers located at intervals along the right of way to 11 000 volts for the use on the trolley The trolley system will be of the inclined catenary type utilising a bronze contact wire and steel messengers, all supported on steel poles and structures. No sub-stations are required for the system adopted for the reason that the locomotives utilise the same kind of current as generated in the power station, i. e., alternating current, single phase.

Carrier Current Telephony

(Continued from page 100)

energy for the tube transmitter and receiver

On the New York street car three 50-watt Radiotrons were used for sending, and an ordinary receiving set with one detector tube and two amplifiers of the UV 201 type for receiving signals. The two transmitters operated on a different wave length and by this means it was possible to carry on a two-way conversation at the same time, just as is possible on the land telephone. Since these wave lengths were greater than 15,000 meters, there was no possibility of any interference with other radio telephone stations.

The successful transmission of voice over electric power lines carrying 70,000 volts by carrier current, a new development of radio, was recently accomplished in Baltimore, Md Tests were made by engineers over the high tension transmission lines connecting a substation of the Pennsylvania Water and Power Company, Baltimore, with its hydro-electric plant at Holtwood, on the Susquehanna River a distance of 40 miles. Conversations were carried on under every possible condition that might occur on a power transmission line, such as short circuits, grounding, and broken wires.

For power companies the carrier current system has many advantages over the land telephone, for, so long as there is a single transmission line in operation, communication can be carried on. Ordinary telephone wires, which are many times smaller than the high power electric lines, are generally the first to suffer during a storm, whereas transmission lines are seldom affected by even the most violent storms.

In the tests made in Baltimore the quality of the speech was much better than that obtained by land telephone over the same route. The conversation was free from hums and other noises which are usually experienced when a telephone line parallels a high power electric system

A small switch connected with an ordinary telephone instrument does all the work. By moving this switch upwards, a bell is rung at the other end of the line The switch then automatically returns to the neutral, or listening position, and the conversation begins. The apparatus is in operation only when a conversation is in progress, the telephone hook holding the receiver acting as a switch for the set.

Instead of radiating the sound waves into space, the high frequency carrier current is transferred to the transmission line by the condenser action of the capacitive coupler, the energy all being imposed on the electric power lines, and in the magnetic field that surrounds the wires.

Fifty watt sets are capable of carrying on communications for a distance of 85 miles. Larger sets of 250 watts are being made that will make it possible to extend the distance of communication to 260 miles.

What Makes Glue Stick?

(Continued from page 102)

if relatively few large pores are present, as in walnut or Spanish cedar, it is obviously essential to penetrate the small cells, or fibers *F*, as well as the pores, in order to obtain a sufficiently strong anchorage for the glue The same condition prevails in the conifers, where the cavities of the summer wood (the denser, darker-colored portion of the annual ring) are smaller than those of the springwood, and hence the summerwood is less readily penetrated than the springwood. When considerable areas of summerwood are present on the surfaces to be glued, particular attention to the viscosity of the glue the temperature of the wood, the pressure applied, etc., needs to be given to secure proper penetration and to insure a good joint. In hard pine and Douglas fir, however, the penetration of the summerwood may not always be necessary, since good penetration of the springwood only may produce a joint as strong as the wood.

Invention and the "Grifter"

(Continued from page 135)

slightly, and though you were Hercules and Samson no blow of yours could ever ring the bell. This obtains in cases where the hammer machine is used for prize winning. Where there are no prizes there is likewise no gimmick, and ringing the bell depends solely on a square and honest blow

Then there are the throwing games. Every American, probably because of youthful baseball or "one old cat," loves to throw All [illegible]

pulse, based upon the habits of the race in savagery, no doubt, but Americans are especially addicted. So the various games of this sort have a perennial vogue.

Every one knows, of course, that the darky who pokes his head through a canvas and allows the boys, young and old, to try hitting it with a baseball—three shots for a dime—has a steel plate and wig of wool on top of his head with a thick felt batting under it.

Other throwing games are full of similar trickeries. I cannot hope to explain them all in a single article. But take the familiar cat rack. There are some dozen forms of it, but the underlying idea is always the same. Yonder, about thirty feet away, is a cat or a row of cats made of canvas and sawdust. Knock the kitties down with baseballs, according to the rules of each individual grifter, and you win the sub rosa candles or the Undertaker's Delight cigars. Usually these cats are so weighted at the bottom that even a speedily thrown ball will do no more than move them unless it hits them at the pivotal point. The grifter tells you where to hit them in all honesty But to use the vernacular—try and do it!

Early this year, at one of the parks, I saw a row of these cats on their bench and long familiarity told me they were not loaded Before the grifter knew what was happening I picked up three balls and, foolishly proud of a good arm, knocked down three of his cats. He immediately and smilingly opened his box of ether perfectos and I declined Quite according to form, since we were alone, he offered me a bet. I declined it to be sure, and he set his cats back on the bench. I asked him what the game was.

"Try and knock them off again," he said drily

I did. Five or six times I hit a cat squarely and with force. The stuffed canvas cats jumped, whirled and danced but they did not fall off the bench

The grifter led me to the back of his "concession" and showed me a painted steel wire stretched across the back of his cat bench When he wanted anyone to win he left the wire loose and trailing but if he desired no winners, he stepped on a plug or leaned against a bar and drew the wire taut. The only way to knock a cat off the bench was to break the wire. I laughed and paid, after I had gone to the front again and satisfied myself that the lights were so arranged that no man could find the wire, even though he knew it was there

"Knock down the cats, boys! Easy as falling off a log. Just a little speed and control! Merely a game of skill, boys!"

The grifter's cry taunted me down the pavement To such devices does the inventive spirit of man devote itself—the same spirit that lifted an ape to Parnassus What can one expect in the good old summer time?

The Reconstructed "Leviathan"

(*Continued from page 109*)

A ship like the "Leviathan" is a floating hotel, and since this is a technical article we can do no more than say that the state rooms, assembly rooms, social hall, restaurant, dining room, etc., have all been thoroughly redecorated along distinctly American lines. While the best features of the German carving and architectural decorations have been preserved, the color scheme has been changed to the soft tones which characterize the prevailing internal decoration of American homes. The cost of the structural and engineering reconstruction, the refurnishing and decoration of the living accommodations, the supervision, maintenance, etc, brought the total expense, by the time the ship reached New York, up to $8,200,000.

Can the "Leviathan" win the "blue ribbon of the Atlantic," which at present is held by the "Mauretania," with a record of 26.01 knots average for the eastward passage? This summer will tell the story With her new improvements, she should have no difficulty in surpassing the "Majestic's" record of 24.6 knots average for the crossing, and every effort will be made to equal the long-standing record of the famous old Cunarder, which has stood for 15 years.

Concrete in the Making

(*Continued from page 105*)

not less than 78 per cent of the finished cement must shake through this sieve. Yet the sieve itself will hold water!

Bronze wire cloth that is woven more finely than silk is the screening agency. A silk handkerchief has only 110 threads to the linear inch—silk dress goods seldom more than 187. Yet this metal cloth contains 200 wires each way to the inch, and the

number in any one inch may vary only within very narrow limits, as the standard specifications for cement govern this point as well as the cement itself.

Into a single square foot of such testing sieve the wire weavers must put a mile of wire. This allows for the extra length required in bending the wires over each other in the weaving. Each square inch of the bronze cloth contains 40,000 holes.

After a sieve is made, it still must be checked before it can be depended upon as sufficiently accurate for cement mill testing. It is either sent direct to the United States Bureau of Standards at Washington, or compared carefully with a sieve that has been so checked. Additional tests of the accuracy of the sieve are made at intervals on samples of known fineness, secured from the Bureau of Standards.

Last year the tonnage of portland cement manufactured in the United States was well over half the tonnage of steel produced, and the weight of the resulting structural material—concrete—was several times as great as that of the steel made. Expressed in units of 376 pounds, the 1922 production was 114,780,984 barrels, according to United States Geological Survey figures.

The volume of construction work in prospect for 1923 is huge, so that demand will doubtless continue heavy during the year. With a potential capacity of some 30,000,000 barrels more than last year's record output, the industry is already equipped to manufacture a substantially increased tonnage if called upon to do so. An average plant today—say one with an annual production of a million barrels—can turn out more cement than was made by the entire industry in 1896. Thus American business expands.

Women on the Farm

(Continued from page 110)

utilization of mechanical power for the field and stable work, a scant 21 per cent of the farm homes which reported in the government survey announced the use of artificial power in the housework. It is a simple matter to harness the gasoline engine so that it will operate various household appliances. Nevertheless, one important agricultural state included in the survey which reported power used on over 50 per cent of the farms also stated that it was used in less than 7 per cent of the houses.

Of the 10,044 farm homes under discussion only 32 per cent were supplied with running water. Sixty five per cent of these homes have water in the kitchen only, fed from a pump or by a rubber hose connected with a barrel just outside the kitchen. Only 60 per cent of these rural homes have sinks provided with drains and in many cases, the water used, has to be carried from the well outside, a pailful at a time. In 61 per cent of these homes, the water is carried by the women. Of 6784 country housewives interrogated about bathroom facilities in their homes, only 20 per cent replied that their houses were equipped with such conveniences.

The passing of the rural hired girl is strikingly demonstrated by the farm home statistics which the government experts recently have assembled. Of 8700 farm families reporting, less than 1 of 1 per cent reported that they hired woman help throughout the year and only 14 per cent of them stated that they were able to get extra woman help for even short periods during the peak of the harvest, haying and silo-filling periods. From eight to ten per cent of these rural families aim to hire extra woman help an average of 1¼ days a week, for laundry work and cleaning but rarely are able to secure dependable labor of this kind.

Thirty-six per cent of the women interviewed said that they helped with the milking, 56 reported that they cared for the home gardens without any assistance, 81 per cent take care of the farm poultry, 25 per cent help with the live stock and farm chores and 24 per cent assist in the actual field work an average of 6.7 weeks each summer. Furthermore, 35 per cent of these farm women make butter once or twice a week for home use and to sell.

Thirty per cent of these women keep house accounts in addition to the general farm accounts on which they keep tab for their husbands. The records show that 11 per cent of the women selling butter and 16 per cent of those marketing eggs have the resultant money for their personal use. It is of interest that the average of these 10,044 farm homes was 5.9 miles from the nearest high school, 2.9 miles from church and 4.6 miles from the nearest market in addition to being 5½ miles from the family doctor, 13 miles from a trained nurse and 14 miles from a hospital. Despite that 62 per cent of the farms had automobiles and 72 per cent telephones, experience in first aid and elementary nursing are essential if the health of the farm family is to be properly attended to. Illustrative that the country is not as healthy a place to live as some people would have us believe under existent conditions, it is particularly mention-worthy that 30 per cent of the farm families reported one person entirely or partially incapacitated by old age or chronic illness. It is also worthy of note that 7467 typical farm families in different sections of the country report an average for each home of but 1.18 children under ten years of age and .89 between ten and sixteen years of age. As our future agriculture depends on the rural birth rate and subsequent raising of the children, this survey emphasizes the need for better living conditions in the rural home so that child mortality will be curtailed.

What Is Color?

(Continued from page 112)

then the color belongs to the "dull" series. It is evident that only two of the quantities in the equation need be known, for the third can then be found at once.

For instance, the designation 0.60—22—40 denotes a grayish yellow. The fact that it is yellow is derived from the figure 0.6, which refers to the position of the color in the color circle. The figure 22 indicates that the color contains 22 per cent of the pure color tone, while the figure 40 shows that its content of white is 40 per cent. By the use of the equation mentioned above it is possible to find the black content to be 38 per cent.

In determining the composition of any color, it is necessary to have an Ostwald color circle and a means of mixing the colors optically. The purity of the color may be determined by choosing a color tone that resembles the color under examination most closely and by adding to it various amounts of white and black until the color is matched. The light filter may also be used in this analysis. The color tone can be found by the use of an optical mixing device, either a rotating color disk, a polarizing color mixer or a Lambert mixer.

We have spoken only of colors consisting of one color tone. A great many colors, containing more than one color tone, are possible. It has been estimated that there are about four and one-half million colors containing two color tones that could be prepared. About one million more could be made from combinations of three color tones. It is evident that the number of colors is extremely great and the question arises whether so great a number of colors is at all necessary for our needs.

An analogy has been drawn between music and color. In each octave there are twelve tones, but from these twelve tones there can be produced thousands of variations. These twelve tones seem to be absolutely sufficient for all our artistics in the realm of music, which no one will doubt affords one of the finest ways in which the artistic temperament is expressed. There does not seem to be any need for a great number of colors, for after all the intrinsic variation between members of the series becomes rather small as the number of colors increases. It is held that between 500 and 3000 colors would be more than plenty for all purposes. We could still get all desirable variations and novel effects in dress, in interior and exterior decoration, in all the fields of human endeavor where color is of importance, with these colors. Ostwald has proposed the use of 15 dull colors or grays and 2520 bright colors. There does not seem to be any good reason why there should be more.

In conclusion it might be mentioned that the inventor of this new classification of color, Dr. Wilhelm Ostwald, has written prolifically on this subject during the past five years. There are many books printed in German. The advantages of the classification are too evident to require detailed discussion. The number of dyes is increasing each day, and it has been becoming more and more difficult to identify and classify them by their colors. There is always present the demand to match this or that shade, and it is not by any means limited to the case of the unfortunate man, who has to match his wife's ribbon sample. The usefulness of the Ostwald classification to paint makers, dyers, textile works and in the lives of persons intimately connected with color is indubitable.

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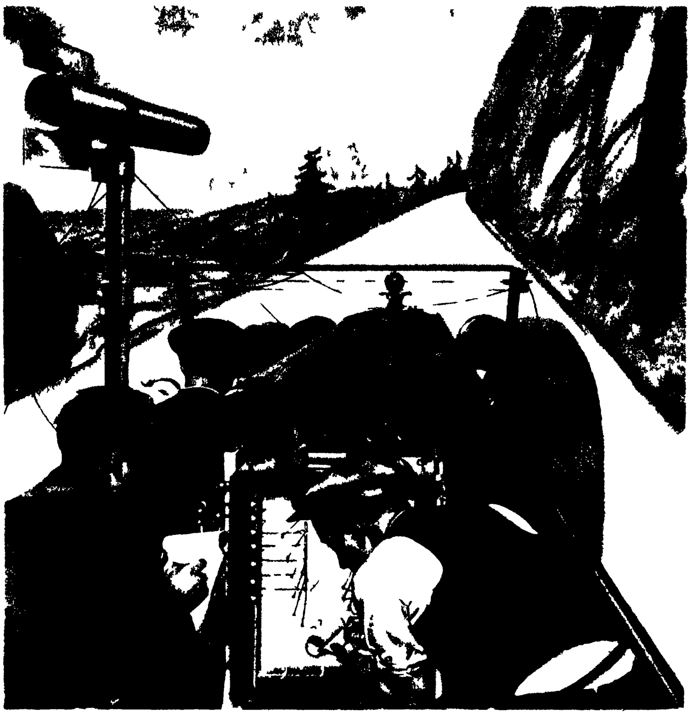

DETERMINING SIXTEEN BRANDS OF AUTOMOBILE PERFORMANCE ON THE ROAD [S [illegible] 6 [illegible]]

Scientific American Publishing Co., Munn & Co., New York


When you arrive at the point in your business where you carefully investigate upkeep and operating expense with the idea of lowering the cost of delivery with your motor truck ~ when you decide that yearly depreciation of haulage units should be less ~ then you'll go to Federal Truck Distributors and get the facts about Federal Modern Design.
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BALL BEARINGS

The Highest Expression of the Bearing Principle

The Scientific American September 1923 Volume 129 Number 3 Published monthly by Scientific American Publishing Company at 233 Broadway New York N Y and printed in the U S A
Subscription price, $4 00 per year Entered as second-class matter June 18, 1879 at the post office at New York N Y under the act of March 3 1879

With the Editors

"YOU have sixteen ohms of malaria," exclaimed the man at the rheostat handles to a member of the SCIENTIFIC AMERICAN editorial staff who has been investigating in a preliminary way the intricacies of the much-disputed electronic Reactions of Abrams. Never has a subject attracted so much attention in and out of medical circles as this new method of diagnosis and treatment developed by Dr. Albert Abrams of San Francisco. The "ERA," as the Electronic Reactions of Abrams method is termed for short, has its staunch advocates. There are ERA practitioners throughout the country. Remarkable cures are said to be effected through this latest therapeutic agency, and there are a number of apparently well authenticated cases of cancer cures. But on the other hand there are many, many doubters in and out of medical circles. Attack after attack has been delivered against ERA. Still the matter remains an unsettled controversy. The public, looking on, remains in a quandry.

EVERYWHERE throughout this country one hears the pointed question: How about the Abrams electronic reactions? We receive letter after letter asking us for our opinion regarding what sooner or later must prove to be the dawn of a new era in medicine or a rank fraud which has assumed serious proportions. A member of our staff recently toured the Middle West and came in contact with numerous men in divers fields—writers, editors of magazines, journalists, advertising men, manufacturers, salesmen, mechanical engineers, and so on. The topic of conversation which never failed to arouse the greatest response was Dr. Abrams and his electronic reactions. And why not? After all is said and done, our greatest concern, no matter what may be our life's work, is the welfare of our body. Anything which tends to make us better men must receive prime consideration.

JUST as we committed ourselves to an investigation of psychic phenomena, which has now been under way for many months, so we are going to undertake an investigation of the Electronic Reactions of Abrams. Frankly, it is a very difficult task, requiring almost no end of research in the field and in the laboratory. We shall invite the advocates of ERA to present their side of the case. Already our preliminary work has been greatly facilitated by the hearty cooperation of an Abrams practitioner in New York City. We shall invite the medical fraternity to aid us in our investigation in a broad and unbiased spirit quite in keeping with our own open minded attitude. Numerous tests will be made and the results reported to you in due course. But—and this is a point for you to remember—do not expect an immediate solution of the Abrams mystery. It is going to require much time in order that the investigation may be worthy of its sponsors. In the October issue we hope to have something to tell you regarding some preliminary impressions of the Abrams method.

ONE of our regular correspondents has been spending several weeks in Washington going over reams of reports and statistics. He is now down South looking into the big projects in the planning and in the building for that vast territory which is rapidly developing along industrial lines. This correspondent is working on the subject of water power. He is seeking the leading opinions of the nation. He is delving deep into our water resources. His first article will appear in an early issue and will be followed by others, so as to develop a complete survey of the water power situation and its future. This series on water power will be a feature of a virile campaign for cheaper power, involving for the most part the vast potentialities of our water resources, but also dealing with coals and lignites and oils and other power producers. Cheaper power remains the very backbone of industrial life, not to mention its important rôle in the American home.

FROM the article entitled "A Small Private Laboratory," appearing elsewhere in this issue, something may be learned regarding the remarkable Riverbank Laboratories. The members of our staff who visited the laboratories and was treated to a veritable surprise party returned with a goodly supply of data and photographs from Riverbank. The present story is a general account of the Riverbank Laboratories, so it remains for subsequent issues to tell you in detail of some of the interesting investigations now being conducted there. Most important of all, however, our visit has served to establish pleasant relations with Riverbank, so that we may keep in touch with developments in the future.

RECENT progress in aeronautics has been almost bewildering in its extent and variety. The world's speed record now stands at nearly 245 miles per hour. Awe-inspiring endurance records and a non-stop coast to coast flight are likewise to the credit of our Army Air Service. Engines on full power tests are now expected to run 250 hours continuously. Gliders remain aloft for many hours with nothing but air currents and the skill of their pilots to sustain them. Helicopters have risen vertically, hovered over a given point, made complete circuits in horizontal flight. Airplanes have been attached to dirigibles while both types of aircraft were in rapid flight. Metal is displacing wood in the construction of airplanes. Pilotless planes carry out complicated evolutions. These and many other remarkable features mark the rapid progress of aeronautics, and rather than deal with each feature by itself we have thought it best to review the recent progress of the art in one essay in order that each feature could be given its proper standing and place in the whole scheme of aeronautics. Our review of progress in aeronautics will appear in our October and November issues. It has been prepared by Alexander Klemin, well known lecturer in aeronautics at New York University.

SMASHING dishes to learn how to make better dishes; how water power has paid for the paving of a town's streets; why armored suit inventors leave home; the latest developments in man-made lightning; recent ambitious undertakings in concrete construction; what happens when wood shrinks; how fabrics are waterproofed; the poisonous plants of the usual garden; ingenious uses of the welding torch; the energy of the atoms and the possibilities of applying a harness; the story behind the Underwriters Laboratories label; how our automobile fuel is brought to us—these are but a few of the subjects which will serve to make the October issue of the SCIENTIFIC AMERICAN more interesting than ever.

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SEPTEMBER, 1923

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway New York

Founded 1845

CHARLES ALLEN MUNN, President — ORSON D MUNN, Treasurer

ALLAN C HOFFMAN, Secretary

Vol 129 No 3. Published monthly. Entered as second class matter June 18 1879 at the post office at New York N Y, under the Act of March 3 1879.

Price 35 cents a copy. $4 00 a year. Postage prepaid in United States and possessions and Mexico Cuba and Panama. $4 50 a year for Canada. Foreign subscriptions $5 00 a year postage prepaid.

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, SEPTEMBER, 1923

A Nation of Milk Producers and Users

THE United States is a wheat-producing country, par excellence; yet the value in 1922 of our entire wheat crop is but one-third that of the dairy products—milk and cream, butter, heese, and the other things that come out of the milk ail. Cotton has been king, and will be again, if he is ot actually on the throne at the moment, but the eecy staple produced on all our farms is worth barely alf as much as the output f all our cows. If we add ito a single item the potato, nts and tobacco crops, they ill total only a little bit iore in value than milk and ilk products. We are the reatest live-stock nation in ie world, yet if we were to ring into the market for laughter and sale every eef animal, every lamb nd sheep and every hog i the United States, we iould find that the proeeds would not pay for the airy products of a year he dairy products are proiced without destroying the airy cows, who go right head next year as last, nd the procedure suggested ould wipe out the meat erds. That is to say, the utput of the milk industry i equal to the entire capital tock in trade of the meat industry!

Dairy cattle in the United States number approximately 30,000,000 head. They are found on approximately 4,500,000 farms—70 per cent of our agricultural establishments including milk among their crops. On the farm, milk and milk products for 1922 were valued at $2,090,450,000; by the time they had reached the ultimate consumer they were worth more than three billions.

Our drawing shows sufficiently the distribution of this immense total, save that it does not indicate what is left for inclusion in the "miscellaneous" item. This goes into the manufacture of milk powder, malted milk, and other minor commodities, and allows also, for the wastage and losses incident to manufacturing processes.

We have in operation—or had when the census man went his rounds—8995 creameries, 2888 cheese factories, 558 condensed milk establishments, and uncounted thousands of concerns engaged in the distribution of milk, the manufacture of ice cream, and in other collateral aspects of the dairy industry.

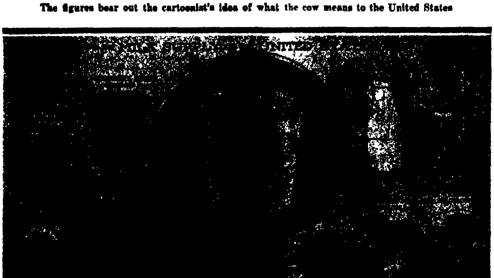
The average milk production of 25,000,000 cows that are being milked in the United States today is 4021 pounds per year. As showing what breeding will do, many animals yield 10,000 pounds, a number 20,000, and a select few 30,000 or more. The Department of Agriculture, making due concession to the obvious fact that every farmer cannot have a herd of prize cows, believes that due attention to feeding and breeding would double the national average.

A simple division of 11,000,000,000 gallons by 108,000,000 people will indicate that we produce 100 gallons of milk for each man, woman and child. Of this, we drink seven gallons more per capita than we did in 1914. Our city dwellers drink, or use otherwise on their tables, an average of a pint of milk per capita per day. The individual ration of butter throughout the country was 16 pounds for the year, and any reader who did not eat 2¼ gallons of ice cream in 1921 was not getting his fair share. Our annual consumption of cheese, as might be expected, is far below that of many European countries, coming to only 3.7 pounds per capita. If we ate cheese with the Danes, English, Dutch, French or Germans, we should have a market for nine billion pounds of milk beyond our present mark.

Wisconsin is the premier dairying State, having maintained the position since 1920. On January 1, 1923, there were 2,195,000 milch cows in this State. New York and Minnesota came next, with 1,678,000 and 1,641,000, respectively. Illinois, Iowa, Pennsylvania, Ohio and Texas also have each more than a million cows in milk production.

Speaking of the condensed milk end of our dairy industry, it is of interest to learn that the annual output of cans, placed end to end, would encircle the globe not quite five times. To fill these cans requires the milk of over 900,000 cows. A year's production of canned milk, packed in cases, would duplicate the pyramid of Cheops, which measures 495 feet from the base to the peak. A train 490 miles long would be needed to haul at one time a year's output of condensed milk. One year's output of condensed milk represented 2,031,000,000 pounds in the can, and 4,504,000,000 pounds in the raw milk state. Condensed milk contains 30 per cent milk solids, 30 per cent water, and 40 per cent cane sugar.

The figures bear out the cartoonist's idea of what the cow means to the United States

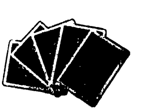


The distribution of our annual milk crop among its various uses, both in percentage figures and in pounds, is indicated in the above graphic statement

Evaporated milk is unsweetened milk, the reduction in bulk being obtained by the elimination of much of the original water content.

It is said that through the condensing and evaporating of milk we are saving in freight handling some 1,200,000 tons annually. Not only in reduced freight costs but in other ways the condensing and evaporating of milk has proved a great boon. In many parts of our country, particularly the South, milk is not obtainable in the fresh state and reliance must, in part, be placed on canned milk, which thus becomes an indispensable feature of the diet rather than an emergency measure.

The symbolic Uncle Sam has been represented as serving in many capacities—guardian of the treasury, soldier, diplomat, agriculturalist, postal official, naval officer, and so on. This distinguished personage, it appears from the above figures, might better be shown with an apron over his clothes and a milk can in his hand. Of a truth, the philosopher was right who remarked that the human animal is a parasite upon the cow.



The Inventor and the Gay Gambler

Ingenuity Ranging from Marked Cards to Crooked Roulette Wheels for Separating the Fool and His Money

By Edward H. Smith

IN THE misty prehistory of India there lived one Raja Yudhishthira, a first-class gambling man. He is the Odysseus of the Mahabharata, that great epic whose principal parts probably date half a thousand years before Jesus. His was the Pandava family, constantly at war with the cousin, Kauravas. I cite from Wheeler's translation of the poem:

"And it came to pass that Duryodhana (chief of the enemies) was very jealous of the triumph that his cousin, Yudhishthira, had performed, and he desired in his heart to destroy the Pandavas and gain possession of their raj. Now Sakuni was the brother of Gandhari, who was the mother of the Kauravas, and he was very skilful in throwing dice and in playing with dice that were loaded, insomuch that whenever he played he always won the game. So Duryodhana plotted with his uncle that Yudhishthira should be invited to a match at gambling, and that Sakuni should challenge him to a game and win all his wealth and lands."

Yudhishthira lost all his wealth and lands and his kingdom, right enough. Worse yet, he staked the sacred polyandrous wife, Draupadi, against Sakuni's queer dice and lost her into the bargain. After many wanderings and adventures he, however, regained all and even reached the sunlit heights—so that a gambler evidently may enter the kingdom of heaven.

Yet this is hardly the point. What is worth noting is the fact that in the day of Cyrus, Buddha, Nebuchadnezzar, Crœsus, the first Mikado, Pisistratus, the last Tarquin and the first Roman consuls, and other such far-off worthies, someone had invented crooked implements for the gaming table: yea, probably long before! Thus the gambler inventor, though he rank not with the man who chipped the first flint hand ax or fashioned the stone skull crusher is, nevertheless, one of the earliest improvisers of the instruments of civilization.

The disastrous dice of Yudhishthira were called *conpas*, and the modern gamester might have some difficulty deciding that they had not been made last week in Chicago. A number of these ancient and faithless cubes were thrown from the veritable box still in daily use or misuse. We know that the Romans dallied with the same perfidious *tales* and any anthropologist will tell you that the darky's devotion to the galloping ivories may be partly the scurvy inculcation of the white man, but is at bottom the deep tradition of a similar instrument of treachery and glory, much used in savage Africa.

So, the first emotion that sweeps us when we think of the connection between invention and gambling is a sinking of the heart at man's ancient and unregenerate roguery. Men were loading dice before they had dreamed of the globular earth, they had swords of steel while they were still ploughing with forked sticks. And rightly so, perhaps.

The uninitiate modern gentleman, when he travels in a Pullman compartment and plays a disastrous game of poker with affable strangers is appalled when he discovers later that a pack of marked cards has been his undoing. Yet listen to George Devol, the famous old Mississippi River gambler, writing of an event before 1850:

"While waiting at Donelsville for a boat to take me to New Orleans, I fell in with a fellow who proposed a game of cards to pass the time until the boat arrived. We went into a saloon and sat down to play a game of poker. He brought out an old deck of marked cards, which I recognized the moment I saw them. We began to play. I knew the fellow took me for a sucker, so I let him play me with 'his cards' until I got a chance to down him, which I did, for all he had."

So, whether one look down the distant vistas of time or merely glance at the immediate past of our own country, the result is the same. We find the "fixed" gambling device in use everywhere. The inventor of such infernal stuff has been at work since the beginning. But more laughter or indignation kindles (according to temper) when we find that today the invention or devising of crooked implements of the game is an organized business; that large factories exist which turn out marked cards, loaded dice, fixed roulette wheels and many other such pretty instruments by the thousands. Once this is realized, we are not further disturbed to find that every experienced gambler marks his own cards, loads his own dice and contrives other "controls" of his weapons.

The interest, then, lies rather in what these inventors and improvers have achieved. It is a well known principle of gaming that the nature of the trick must be varied from time to time as the sucker becomes suspicious of or familiar with one fraud after the other. It is this fact that keeps the inventor and adapter ever at work. Since dice seem to be the most ancient and simple implements of play and cheating, we may as well see what has been done in this field.

All dice are fixed in one of two ways—dice used for the everlasting game of craps, I mean. Some are so corrupted that the advantage will lie with the player. These are commonly called passers or hitters. The others are arranged for the benefit of the banker or fader (whoever bets that the player will not make his point). These are known to the gentry as missouts, faders or banking dice. In almost every instance the same method used for making passers can be employed for producing missouts. It is merely a matter of causing opposite combinations of numbers to turn up. For instance, if the player can be sure that the numbers 4, 6, 8 and 10 will turn up almost invariably, he has a considerable percentage, since the fatal craps numbers 2, 3, 7, 11 and 12 will turn up less frequently. Of course, the player who uses such a set of "bones" gives up the advantage of occasional showings of the winning 7 and 11 on the first throw.

We need not go into the older methods of producing such results. Indeed, it is not necessary to give more than passing mention to the fact that transparent dice are now loaded with invisible bits of platinum behind the spots or that dice are now made which can be changed from passers to missouts by striking them against the table sharply in various manners, explained in the directions which the makers of these nefarious implements supply with each set sold. Mis-shaped, misspotted, adhesive or suction dice are all fairly well known and ingenious enough. But there are recent developments in this field to merit more careful attention.

Within the last three years one of the professional inventors of crooked dice has brought out what is called the capped die. I quote from his own description:

"In making these dice a cap or face of specially prepared material is permanently attached to certain sides of a blank die. This is done so cleverly that the joint is absolutely invisible, but the composition of this cap is such that a die so prepared will show a strong percentage when used on a billiard table or other hard substance of similar texture. These dice can be used where shaped (mis-shaped) or loaded dice would be detected immediately."

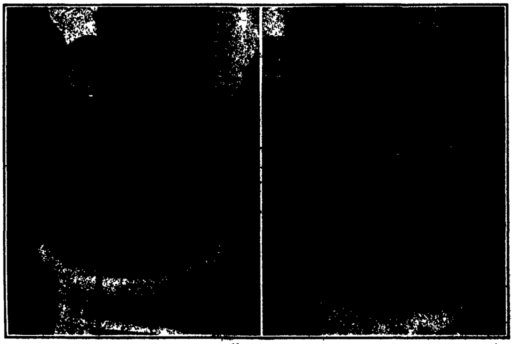
But the making of unfair or percentage dice long since passed out of the field of the merely physical and come under the purview of chemistry and electricity. Various kinds of celluloid dice are now made whose weight on certain faces can be definitely changed by the application of chemicals. I quote from the catalog of one of the big manufacturing firms:

"Our special magic liquid, when applied to transparent dice according to instructions, will afford the operator a handy and efficient method of making percentage dice. This liquid is compounded from our own formula and penetrates the faces of the dice to which it is applied, causing a change in the chemical composition of the celluloid. This results in bringing up the desired faces and gives the operator a good percentage. The work will last indefinitely."

I suspect, of course, that the magic liquid is nothing but a drop of acid, which actually does change the nature of the celluloid to which it is applied, making it weigh less. Thus, if I want the number 6 to turn up on a die, I touch that plane of the die with the acid, and lo, the job is done.

But the most intriguing of all these pleasant inventions for the swift division of the fool and his money is the magnetic money drawer or showcase humidor. Both work on the same principle, so it will be sufficient to describe the humidor, which seems most mysterious to the layman. This device is most used in cigar stores where much shaking for cigars or money goes on. Its siren charm is based on a common misconception. Everyone had been told that glass is a non-conductor, against which electricity has no power. Naturally, no one but the technician believes that dice can be controlled through the top of a thick glass plate by electric means. The secret lies in the difference between electric current and magnetism.

Accordingly, an electromagnet, enclosed in a box which looks like a humidor, is placed in the show case, surrounded with the usual array of cigar boxes. Some are even arranged with a



Left: The victim believes that because this roulette wheel is covered and the dealer cannot see the ball or the numbers when spinning there can be no cheating. He does not know, however, that the lid that is supposed to protect him actually betrays him. The dealer is about to spin the ball into the funnel top of the lid. When it descends, however, it runs through a tube and invariably comes out at the same spot, just under the screw with the perpendicular cut. *Right*: The same roulette wheel with the lid lifted. It had been set at 22, and the ball is in that slot.

Covering the roulette wheel by no means protects the player

Here is the practice known as 'dealing seconds. The dealer has slipped back the top card slightly, to get at the one beneath, and to retain the top card

Continuation of the "dealing seconds' manipulation Here the dealer is seen pulling out the "second.' This is done with extreme rapidity and is generally not detected

The 'raised deal" The dealer is raising the cards as he passes them out, so that his partner directly opposite may see what goes into every hand

Some tricks of the crooked dealer which take card playing out of the games-of-chance category

layer of fancy-sized cigars just under the box lid, in case any curious customer or dice player might ask to be shown. This magnet derives its power either from a series of dry cells or from a connection with the lighting circuit, the latter being the final refinement. The magnet is, of course, so raised that it is directly under the glass top and magnetizes a field perhaps 6 x 6 or 8 x 8 inches in dimensions.

The rest consists of a foot lever switch and a set of electro-magnetic dice. The keeper of the cigar store stands in such position that he always dumps his dice on the magnetized field and naturally throws the high and winning faces. The moment his opponent throws, however, the dishonest merchant lifts the foot switch and the field is no longer magnetized. The percentage in favor of the man at the switch is very great. Nobody but a professional gambler is likely to suspect the device and such worthies are unwelcome intruders in dens of this sort.

Cheating at cards is a subject for long and scholarly investigation. Probably their marking originated with the Chinese who invented them, many centuries before they reached Europe. Speaking broadly, there are two methods of crooking cards—marking their backs so that the keen-eyed gambler knows what every player holds, and trimming the edges in various ways to assist in crooked dealing. Marked cards are called readers, those trimmed at the edges come under the general classification of strippers, though some are not trimmed for stripping but for high and low cutting. These terms will hardly need explanation among card players.

Marked cards can be and are being made in scores of ways. There are, first of all, the ready-made readers which can be bought from the same manufacturers who turn out the crooked dice devices. They are made up in an almost infinite variety of patterns with almost invisible markings, such as a slight dimming or darkening of a line or figure at certain places, to indicate, aces, kings, queens, jacks and tens, the important cards for poker. But the cleverest gamblers usually shun these patent readers for the reason that the next man may be as familiar with them as the gamester himself. Accordingly, the gentry make their own readers in many ingenious ways. A pointed piece of spermacetti, wax or resinous pine, drawn across the back of a card will leave a glossy trail which can only be seen when facing a strong light. The gambler sees to it that he is placed to see. Coating the edge of a finger or thumb nail with India ink enables the gamester to mark important cards at the edges while he is playing. Sand, glass, emery, resin and acids are used to remove the glossy finish from certain portions of a card's back, and the sensitized fingers of the gambler then reveal what he is giving to this man and that while he deals. When he comes to a desirable card he holds it on top and deals the next card underneath by a very simple sleight-of-hand trick. His partner or he himself gets the good card and the next good one. In this manner he fills up hands for himself or his confederate.

Other ingenious ways of marking are by a fine pricking of cards near the edge by means of a finger ring on which is concealed this fine point or "peg" daubing the cards along the edges with very slight finger prints of blue or red, according to the color of the deck in use, the color being got either from soft red and blue pencils or from tiny pillboxes of color in the opposite vest pockets, touching spots on the back of cards with volatile oils which darken the backs at the given points long enough to make them readable for the period of the game but disappear later through evaporation, touching the edges of cards at fixed points with a strong solution of gum Arabic, and many other methods.

But playing with marked cards is only the beginning of the roguery which has been applied to this antique pastime. The inventions used are almost as numerous as the fools who play for stakes.

Little mirrors or "shiners" cunningly affixed to a pipe which the gambler lays down on the table as he deals, or attached to a box of matches or to the table itself, enable him to see the faces of the cards as he slips them off, one by one, in dealing. Such tricks are old. The inventor of recent years has devoted himself mostly to the card holdout machines, of which there is a staggering variety. Everyone remembers the gambler who slipped an ace up his sleeve. But supposing you have this man outfitted with a concealed mechanism which takes the aces up his sleeve, into his vest pocket or into the vest or shirt front with magic swiftness and silence. Suppose such a machine is capable of passing down into the concealed hand of the gambler a "cold" deck exactly like the one with which you have been playing, at the same time taking the true deck up the other sleeve out of the other hand of the evil magician. Must I explain that a cold deck is one that has been stacked so that the cards will fall in a fixed order giving the sucker a big hand but the gambler a still better one?

Such mechanisms are known by various names which usually indicate their manner of operation. There are arm pressure holdouts, which operate by pressing the arm against a rubber bag concealed in the sleeve. Pressing the bag sends the hand of the holdout machine down the sleeve to grip or give up the desired card. This hand is always an ordinary steel clip, such as may be commonly seen in offices where large stacks of papers are to be held together. There is also the knee-spread holdout. This is worked by means of cords concealed under the clothing and issuing through small vents in the trouser legs at the knees, where they connect. By spreading the knees a little the mechanism in the sleeves pushes down to receive or release the cards or the cold deck. Again we have the chest expansion or breast holdout machine, which is motivated by inflating and deflating the lungs. These machines are always operated by a gambler who wears his coat, which may be marked for its long and loose sleeves. Accordingly, many partly informed men refuse to play in a game unless all remove their coats.

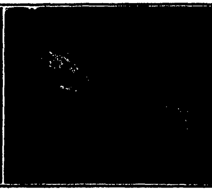
But here again a little wisdom is a dangerous thing. The inventors who serve the gambler have in recent years devised a holdout machine which required no coat or long sleeves. Here is the official description by its inventor and maker

(Continued on page 215)

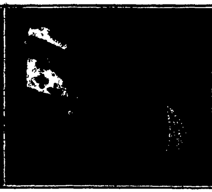
Left: Dealing from the bottom. The dealer does not hold the deck in this position in practice, but keeps the faces down. In the illustration he is holding the deck up to show the manner in which a ten of clubs is got from the bottom again with extreme rapidity. *Right* Dealing strippers. The high cards are wide at one end and the low cards are narrow so that the dealer can strip out all the desirable cards by pulling the deck apart with the fingers along the edges, as shown

Dealing from the bottom and dealing strippers

Palming a card. The deck is held so that the top card may be slipped into the palm of the hand with the right thumb



The card held in the palm in a natural and positive manner. The crooked gambler uses this hand freely without arousing suspicion



Another instance of bottom dealing. The dealer is holding the deck in a suitable manner to facilitate bottom dealing at his convenience

One should always be suspicious of the dealer who moves back the top card. It is the first step in "dealing seconds"

How the dextrous hands of the crooked gambler serve him to good stead

Camps of the Central Circle

Recognition Given the Automobile Tourist by Mid-Western Municipalities

By Avis Gordon Vestal

United States Forest Service Map at Overland Park, Denver

THOUSANDS of families will "vacate" this summer—and in future summers—by following blazed highways in motor cars bulging with camp equipment. For each portable canvas home there will be waiting, in a choice of cities, free leaseholds of land for a "one-night stand," or even for a restful visit of several weeks. From the Great Lakes to the majestic peaks of the western Continental Divide municipal hospitalities of a surprising number are prepared. Toward sunset the tourist can begin to look for some "latch-string hanging out"—a placard posted by the path, inviting him and his to use the town's free camp-site.

Only a decade ago motor cars were of much less general ownership. Few users had driven across as many as three states in continuous journey. Highways then offered much less comfort to "mo-tourists" bumping over them, choked with dust, wallowing in mud or straying from the intended way. In the fall of 1913 the Lincoln Highway Association was organized. In several succeeding seasons it was mapped, marked, and motored over. Crossing the continent in a "gasoline carriage" once a great adventure, became a safe and comfortable pleasure trip.

The public must have been ripe for this, for the idea spread rapidly, and other transcontinental highways were soon named, financed, improved, and blazed by brightly painted poles. From east coast to western water a choice of many paths may now be had. Numerous also are the ribbons of road intersecting our country quite from north to south connecting Canada with the Gulf via the Mississippi Valley states. To this legion of possible paths may be added the routes of trans-state extent, marked by the cooperative efforts of groups of local highway organizations, or, as in Iowa and Wisconsin, by the authority of state highway officials. What are bettered roads and marked ones for but to be followed far?

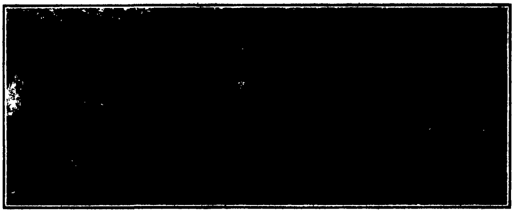
Along the ready roads rolled first the motor cars of the well-to-do, with paid chauffeurs and no dunnage except suitcases or expensive runningboard trunks filled with formal clothes. For the three "b's"—bath, board, and bed—hotels were patronized. It was early discovered that in some cities arriving guests would find the excellent hotel accommodations all bespoken. If nighttime chanced to bring them to some small town they would find only short-order restaurants, with food worse than indifferently cooked, and lodging houses far from meeting the familiar comfort standards. Still farther west, in the sparsely settled portions of the high plains and mountains, there were apt to come hungry times and sleepy hours when no towns of any kind were discoverable. The writer once rode 125 miles in eastern Wyoming, on the Chicago, Black Hills and Yellowstone Highway and found but one tiny village in all that stretch, while ranch houses might be fifteen to twenty miles apart. The remedy was to carry a minimum of food, camp equipment, and water for emergency use.

Just such a taste of seeing a wide country by riding over a certain and comfortable course, lunching in a grove, camping under the stars, and the idea of planning deliberately for camp life all the way grew like a snowball rolled across the lawn in melting weather. Demand and supply met. Purchasable camp equipment was soon improved to meet the limitations of motor portability and to fill all the varied needs of a comfortable "home away from home." A complete outfit could be purchased in one unit, as in the camp trailer, or an outfit could be assembled from a splendid assortment of separate units, from bed to stove, from bucket to refrigerator. The camp phase of motor touring had risen from an emergency necessity to joyful acceptance as a mode of life for the entire trip. "Motor-gypsying" became a recognized part of the "back-to-Nature" movement. And from the cost and kind of many motor cars now carrying full camp equipment it is apparent that many relatively rich roamers have deserted the hotels. Beside them come motorists from the great middle class and the great middle states. Even more in evidence are the numerous "flivvers," with five to seven persons, a dog, and a silhouette like a moving van.

The municipal camp was the next logical step. Not for long did the tourist Meccas along the Rockies look askance at the visitors not putting up in hotels. It was soon apparent that these were decent, law-abiding folk—prosperous farmers, substantial bankers, oil magnates from the southwest, reputable physicians from Iowa, school teachers from Illinois, Missouri merchants with a good rating—all with coin of the realm in the pockets of their khaki. Far-sighted boosters saw the drift—and established free municipal camp-sites. By 1916 a number of Colorado cities were offering such hospitality, as were a few other towns in the scenic parts of other states popular for vacations.

But the central states? Tourists had been hurrying through them, pitching tents by the roadsides. There was no invitation to "stop and shop." By 1917 a few towns began to permit camping in some public vacant place, but seldom was any provision made for comfort or to encourage lingering. But the close of the war saw a great boom in the establishment of municipal campsites by the cities of the central plains. Many of the residents of these states had themselves tasted the joys of nomad life and brought back inspiration from the host camps they had visited in the mountains. The last five years a rapidly increasing number of host towns have been gathering guests from the highways and byways by posting invitations at their city limits, or even many miles beyond on the main roads.

The usual evolution begins with the tentative opening of some vacant lots at the edge of town or with the corner of an existing park. If no shade exists, trees are planted and watered. If the site chosen is beyond the community conveniences, or if the little town lacks them, wells are sunk and sanitation provided. Within a season or two the invitation boards along the roads are supplemented, in some cases, by neat printed folders distributed through garages or by the Chambers of Commerce. These give the location of the camp, what comforts it offers, what points of interest may be visited, what recreation facilities are offered. The attractions may finally come to include some—in the very largest camps perhaps all—of the following: free fuel, usually wood, but sometimes gas or electricity, fireplaces or stoves, lights, running water, sometimes with special provision for washing cars, shade, shelter for cooking center; comfort stations with modern plumbing—which may include shower baths and laundry tubs, occasionally even a washing machine and electric flatiron, portable or permanent tables and benches. Sometimes a general store is set up near by or the local establishments extend service to the grounds.

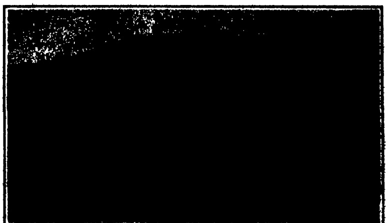


Fireplace in a public camp at St. Louis, being put to good use by automobile tourists

To induce transients to stay over, recreation is being increasingly developed. The things established for local residents are shared and often added to. Playground apparatus, boating, bathing, swimming, or fishing, golf, tennis, or baseball, in the larger cities, visiting the museum, zoo, or music centers, dancing, visiting nearby points of historic or scenic interest.

The forces most active in establishing these camps are local divisions of the big highway associations, Chambers of Commerce, garage men and dealers in automobiles and accessories, civic clubs, park boards, women's societies, boy scouts, campfire girls. The point of view may often be "enlightened selfishness," but results are worthy of the efforts so liberally expended.

Where only existing comforts are offered upon grounds already provided with park caretakers the additional cost is not great. When utilities are added to improve the grounds the cost is sometimes borne by city tax funds apportioned for park development. More often, however, the additions that are made and extra labor required are paid for by organized private interests, such as the Commercial Club or Automobile Club.



Comfort station in the public camping ground at Canon City, Col.

Electric light, running water, fireplaces, shower baths and free wood are among the things provided at the municipal camping ground in Pueblo, Col

The merchants derive benefits which compensate them. A camp does often help to "put a town on the map," and occasionally visitors decide to become residents, while the guests at a camp often spend considerable sums in the town.

Space does not permit consideration of the camps of the entire country, and as those east of the Alleghenies are few, while those west of the Rockies are better known, we have limited ourselves to the central states *through which* motorists used to pass on their way to mountain or seashore, but *in which* they may now find lingering a pleasure. With Ft Riley Kansas, approximately the geographical center of the country as a hub with a radius of about 500 miles, we can draw a central circle which includes all of portions of twenty states of the Mississippi Valley, reaching up the high plains and touching the Rocky Mountain region. The following list of camps is located in this circle. Under each state heading the parts numbered (1) were obtained through questionnaires sent to the Commercial Clubs of two hundred towns, or camps personally enjoyed by the writer, while the parts numbered (2) were obtained from newspaper clippings, from people who had visited the places named, or from the literature of highway associations. The list as a whole cannot pretend to be exhaustive as the number of such camp-sites is constantly increasing.

Wisconsin (1) Eau Claire, Madison (2) Abbotsford, Alma Center Amherst Junction, Augusta, Baldwin Baraboo Berlin, Birchwood, Black River Falls Cambridge, Cazenovia Chippewa Falls Clayton, Columbus, Durand Fall River, Fennimore, Frederic, Hudson, Hustler Kilbourn, LaFarge, Luck Marshfield Mazomanie, Menominee, Merrimac, Milladore Nekoosa, Pepin, Portage Port Edwards, Rice Lake Richland Center Sparta, Spring Green, Spring Valley Waterloo, Wilson, Wonewoc

Illinois (1) Decatur, Dekalb Fulton Medora, Peoria, Wilmington (2) Dixon Ottawa, Springfield.

Indiana, Kentucky Tennessee No camps reported within limits set

Minnesota (1) Austin, Bowlus, Breckenridge, Fergus Falls, Long Prairie Mankato, Minneapolis, Montevideo, Red Wing, Rochester, St Paul Wells

Iowa (1) Charles City Clarksville Clinton, Council Bluffs, Des Moines, Iowa City, Keokuk, Lake Mills, Lyons Marble Rock, Marion, Mason City, Mt Pleasant Sioux City, Tama, Ventura (2) Akron, Chatsworth, Davis City, Hawarden, La Porte City, Little Sioux, Missouri Valley, Mondamin, Northwood, Onowa, Salix, Sloan, Westfield, Whiting

Missouri. Brookfield, Hannibal Kansas City, St. Joseph, St Louis, (2) Bloomfield, Breckenridge, Cameron, Carthage, DeSoto, Farmington, LaClede, Macon, Osborn, Poplar Bluff, Sikeston

Arkansas: (1) Marion.

Louisiana: (1) Shreveport,

North Dakota: No camps reported within circle limits.

South Dakota: (1) Deadwood, Mitchell, Rapid City, Spearfish, Sturgis, (2) Aberdeen, Alexandria, Bridgewater, Canton, Chamberlin, Cottonwood, Custer Emery, Fairview, Hot Springs, Hudson, Huron Kadoka Kennebec, Kimball, Lead Mt Vernon Murdo New Underwood Onkoma Piedmont Plankinton Presho Pukwana Quinn Reliance Sioux Falls Vivian Wall Wasta White Lake Whitewood

Nebraska (1) Chappell Columbus Cozad Fremont Gibbon, Gothenburg Grand Island Kearney Lexington Lincoln North Platte Omaha, Sidney (2) Central City Elm Creek, Valley

Kansas (1) Abilene Baxter Springs Coffeyville Ellsworth Garden City Hiawatha Highland Larned McPherson, Manhattan Marion Pittsburg Salina Wamego Wichita Winfield (2) Dodge City Great Bend Hutchinson Junction City Lyons Newton

Oklahoma (1) Guthrie Miami Oklahoma City (2) Clinton, Granite Shawnee

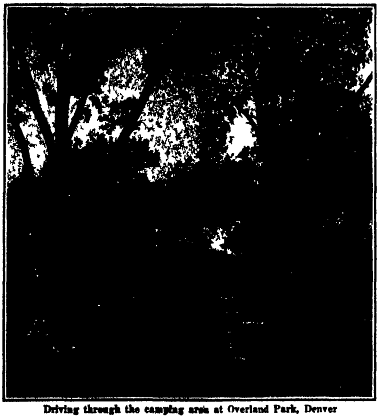
Texas (1) Denison, Ft Worth (2) Wichita Falls

Wyoming (1) Cheyenne (2) Douglas Laramie Lusk Sundance Torrington Wheatland

Colorado (1) Boulder, Canon City Colorado Springs Denver, Florence, Ft Collins, Greeley Longmont Platteville, Pueblo, Rocky Ford, (2) Berthoud Blanca, Buena Vista, Burlington, Cripple Creek, Del Norte, Holly, Lamar, Las Animas Leadville, Limon Loveland, Olney Springs, Salida, Sheridan Lake Sterling, Trinidad, Victor, Wellington, Westcliffe Wetmore

New Mexico (1) Las Vegas, Raton

Thus the automobile tourist is assured of camping space along his route through the central states, and, ultimately, in all states



Driving through the camping area at Overland Park, Denver

Schoolroom Ventilation

THAT a well designed but simple arrangement of window ventilation is the most promising method for classroom ventilation is the striking conclusion reached by the New York State Commission on Ventilation

The commission made a careful experimental study of the effects of atmospheric conditions on health and efficiency carried on in a specially constructed chamber in the College of the City of New York, and conducted a practical survey of the ventilating systems in use in the schools of Springfield Mass., New York City, Minneapolis and other cities

The commission found that while window ventilated rooms have less complete air change than fan ventilated rooms this reduced flushing was not objectionable. It was found sufficient to suppress the accumulation of odors and it permitted the maintenance of a cooler air condition which the physiological and psychological experiments of the commission had shown was more favorable for comfort health and efficiency. Furthermore window ventilation did not tend to produce that uniformity of air currents and temperature characteristic of fan ventilated rooms which was found to exert a definitely harmful effect on health by promoting susceptibility to disease and affections of the air passages.

In schoolroom ventilation the commission emphasizes the need of careful temperature control the temperature not to exceed 70 degrees the use of window reflectors to prevent drafts and adequate gravity exhaust ducts not less than eight square feet in diameter. The use of suction fans in the exhaust ducts was found to militate against the success of the system. The commission found that in the average classroom the most agreeable temperature was 67 degrees.

While well devised and controlled systems of fan ventilation with windows closed were found capable of producing excellent results certain characteristics inherent in this method made them definitely inferior to a good system of window ventilation. Where used however, the commission found it necessary not only to have adequate provision of fan motor, duct and register equipment but also to control mechanically and individually the temperature and volume of air supply in each room — *Abstract from School and Society for January 27 1923.*

Fighting the Corn Borer

MORE than 1 000 000 individuals of an important parasite of the European corn borer *Habrobracon brevicornis* Wesmael have been successfully reared and liberated in the densely infested area in New England. It was believed by entomologists of the United States Department of Agriculture that it might be worth while to attempt to introduce it into the badly infested areas of southern Ontario. Following a suggestion to this effect made to the Dominion entomologist, authorization was recently given by the Canadian government for an assistant for this purpose. This entomologist recently visited the laboratory at Arlington Mass to receive instruction in the technique necessary for handling the parasite

"A Small Private Laboratory"

Some General Impressions Gathered During a Visit to the Riverbank Laboratories

By Austin C. Lescarboura, Mem. A.I.E.E.

SOME time ago we received a letter from one George Fabyan of Chicago, which read in part as follows "I have a small private laboratory which is maintained by me for the purpose of investigating that which interests me. It is not a commercial laboratory and I am not interested in securing publicity either for myself or the laboratory. There are, however, several experiments which would undoubtedly be of interest to the SCIENTIFIC AMERICAN *and the public."*

Well, we have visited the "small private laboratory," otherwise known as the Riverbank Laboratories. It proved a surprise party. In the accompanying article, our Managing Editor tells what he saw during his visit to Riverbank. And having established this acquaintance with the Riverbank Laboratories, we shall tell you in future issues of some of the interesting studies now being conducted by that institution, in greater detail.—THE EDITOR

FIVE HUNDRED AND FIFTY acres of rolling country overlooking the picturesque Fox River and dotted with various kinds and sizes of buildings, over one hundred contented men working with the zeal of the true scientist engaged in the work which lies closest to his heart, a vast array of all manner of scientific equipment in the hands of skilled technicians, a quiet, cheerful, healthful atmosphere conducive to creative activities, and last, but by no means least, time, time, and still more time that is so necessary in evolving answers to scientific problems which have long baffled an altogether too busy world—that in brief, sums up the broad impression of how a remarkable man has realized a remarkable idea.

The locale of this story is that stretch of country between Batavia and Geneva in the State of Illinois, some forty miles out of Chicago. The remarkable man is Colonel George Fabyan. His remarkable idea in fully materialized form, is known as the Riverbank Laboratories. And the reason why you have not heard of these things until now is due to the extreme modesty of Colonel Fabyan, who has always made it a point to do things rather than to talk about them.

Where Utility and Architecture Meet

On arriving at the Riverbank Laboratories, one is suddenly confronted by a group of odd buildings. Indeed, the immediate impression is that one is about to engage in a brand new kind of experience, and subsequent developments confirm that first impression. The buildings have apparently been constructed with but one thought in mind, namely maximum utility. Conventional architecture has been cast aside. Particularly as regards one of the buildings, the bizarre feature consists of a step-like effect due to each successive floor being considerably smaller than the floor below it. In this manner the second floor is surrounded by a concrete terrace which is, in reality, the roof of a goodly portion of the ground floor while the third floor is surrounded by a similar terrace which is the roof of the second floor, and so on. The general effect is not unlike the towering structures erected by children with their square wooden blocks.

The Colonel knew what he was about when he planned buildings of this terraced type. In the first place, the various floors have convenient terraces which may be reached by doors. Then, when it is in order to provide additional floor space on any floor it is only necessary to build the necessary outside walls, as well as a concrete slab for the additional roofing and the job is completed. Thus a laboratory building of this type keeps up with developments in much the same manner as the sectional bookcase idea.

Other Riverbank buildings are constructed with wings and towers and other irregularities, always with the paramount purpose of providing the maximum utility. The author does not happen to have a complete list of buildings, but it is certain that there are at least a dozen major laboratory buildings, together with bungalows and barns and garages and tool houses spread out over the vast tract of land.

So much for the buildings externally speaking. Upon entering the first of these buildings, we are amazed at the vast array of equipment. Here is a mechanical laboratory equipped with lathes, drill presses, automatic saws, strength-testing machinery, and so on. We are conducted to a corner of a large room, where a curiously mounted electric motor, driving a countershaft by means of a leather belt and wooden pulleys, and surrounded by delicate testing devices, discloses a mechanical problem on the scientific operating table.

The problem proves to be a test on the relative wind friction resistance of open wooden pulleys with their spokes or webs exposed and the same pulleys with disks that cover the spokes or webs and thus reduce the wind friction. Off hand, even the most thoughtful among us would probably dismiss this wind friction possibility as being quite insignificant and not worth the bother of experimentation. But not so with Colonel Fabyan who, although not a technician himself, has the happy faculty of looking for probable scientific developments in odd corners where none are believed to be possible.

So the Colonel turned his staff on the pulley problem some time ago; and already the experimentation has proved most promising. The author was shown an alternating current motor suspended on ball bearings, the axis of suspension being coincidental with the axis of the motor, while the motor itself was counterbalanced so as to remain in any position to which it was rotated on its bearings. A spring dynamometer was connected with the motor shaft and the speed of the driven pulley was obtained by means of a speed indicator. The amount of mechanical energy consumed was estimated with great care. The wooden pulley was then closed at its open ends so as to cover the spokes or web, and the tests were repeated. Measurements indicated that considerably less power was required to drive a pulley, and the operation was appreciably less noisy.

This demonstration has established the surprising fact that considerable power is now going to waste in many of our large shops where power shafting and transmission pulleys are still used instead of individual motor drive. One pulley alone may show but a small loss, but when this loss is multiplied many times in a large plant, it becomes appreciable especially during these times of high fuel costs.

Delving Into the Mysteries of Sound

Other experiments are being conducted in the mechanical laboratory, for it is obvious that mechanics figure largely in any problem that is being investigated, not to forget the machine shop work connected with general experimentation.

Leaving the mechanical laboratory, we pass on to the sound testing building, which is known as the Wallace Clement Sabine Laboratory of Acoustics. It appears that this beautiful laboratory was built for the researches of the late Professor Wallace C. Sabine of Harvard University by Colonel Fabyan, his friend. This laboratory is a three-story structure of brick and concrete, containing a building within a building, as depicted by our staff artist in the drawing on the facing page.

It was Professor Sabine's wish to produce a building in which all sound from one portion can be completely excluded from another portion, excepting as it passes through a wall whose transmission is being studied. It was no simple matter to obtain this special condition, for sound is an elusive thing which escapes from one confined place to another by various subtle means. But by the application of great skill and ingenious care the problem was finally solved to the complete satisfaction of everyone by Mr. B. E. Eisenhour of the Riverbank Laboratories staff, backed up by the keen personal interest of Colonel Fabyan.

The acoustic laboratory consists of two entirely separate structures under a single roof. It will be noted by referring to the accompanying drawing that the inner room or sound chamber is completely insulated from the outer so far as sound transmission is concerned, having its own walls and its own foundations. The sound chamber, which is below the level of the ground, is entered through steel doors as well as a heavy sound proof door not unlike that of a huge refrigerator. The sound chamber presents a spectacle of utter nakedness, due to its huge size and height, with plain floor and walls and ceiling. Yet there are a few furnishings in the room which are all but lost because of the spaciousness. These add still more mystery to an already mystic atmosphere. In one corner there is a battery of organ pipes ranging from the little fellows with high pitched notes, down to the huge stack-like ones which roar their low notes until everything seems to quake with fear. Diagonally opposite, there is a queer cabinet with hinged doors forming the sloping top, said top having a hole through which protrudes the head of any person who sits in the chair within the cabinet. In the center of the room, some distance above the floor, there is a pair of steel reflectors which turns slowly on the vertical axis and serves to change the interference system and give a uniform distribution of sound intensity throughout the room.

What manner of room is this? It is almost impossible to talk in this chamber, since after the third word is spoken the air is surcharged with the persistent echoes of the first two words, so that one is soon hopelessly swamped by what has already been said. To speak still louder does not help matters, because a moment later the louder echoes come back and tend to drown out still more effectively what is to follow. It now dawns on one that the best procedure is to talk in a very low tone, and to wait after every few words in order to give the echoes a chance to exhaust themselves.

The truth of the matter is that this sound chamber is highly sound tight. It requires about twelve seconds for a given sound of medium pitch to be absorbed by the four walls, ceiling and floor. With the sound absorption qualities of the room known and constant, it becomes possible to test the sound absorption qualities of various materials and structures.

Now on three walls, some distance above the floor, there are doors of steel which cover the test panels. These test panels may be built up of any material or type of construction to be tried out for sound absorption and sound conduction. When a panel is ready for test, its steel door is swung out of the way to expose the panel to the sound waves. The observer sits in the cabinet with just his head protruding, because it has been found that clothing has a marked effect on the absorption of sound waves. Within the cabin, the observer has a board with numerous pegs arranged in order corresponding to that of the organ pipes. Thus the observer can connect a switching device with any desired pipe. The switching device consists of a button which is pressed to start the organ pipe, and which starts a stop-watch movement the moment the button is released to stop the organ blast. The observer listens carefully until the organ note has just become inaudible, and again presses the button, this time stopping the watch and obtaining a reading in seconds and fractions of seconds. Obviously, this reading indicates what effect the test panel has had on the sound absorption qualities of the sound chamber, and makes possible the compilation of invaluable scientific data covering the sound absorption characteristics of various materials and types of construction.

So much for the sound absorption experiments. The same arrangement is also employed for sound transmission experiments, so as to evolve better partitions for our apartments and homes and office buildings. It

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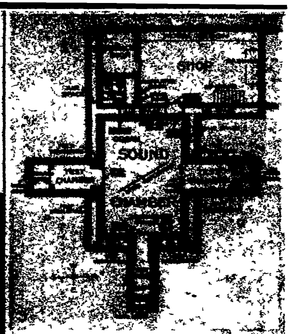


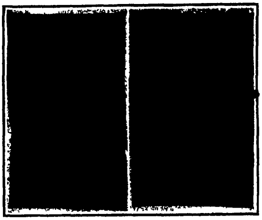
THE outstanding feature of the Riverbank Laboratories is the Wallace Clement Sabine Laboratory of Acoustics, constructed in 1918 for the late Professor Sabine of Harvard University, and in which Professor Sabine's original program of experimentation with sound waves is being carried on. This attractive three-story building, of concrete and brick, consists of two entirely separate structures under a single roof. The inner room or sound chamber is completely insulated from the outer so far as sound transmission is concerned. Separate foundations are used for the inner and outer buildings, and felt insulation is employed wherever the walls come close together to form a connecting doorway. Sounds produced in the inner or sound chamber can be tested with the utmost precision, and exact data obtained.

In the first view we have a photograph of the beautiful laboratory building and its memorial tower. The three wings, two of which show in this view serve to house the test chambers as indicated in the third view or plan of the ground floor and sound chamber.

The second view shows the construction of the inner and outer structures. For the purpose of simplicity this view does not show the test chambers which are in the three wings of the building. During tests of the sound reflection and sound transmission properties of materials, the observer sits in the cabinet in one corner of the sound chamber. Any pipe of the organ, which has 73 pipes, giving all the tones of the musical scale from C, 64 vibrations per second, to C, 4096 vibrations per second, can be sounded from the observer's cabinet by means of a switchboard arrangement. The observer sits in the cabinet with just his hand exposed in order that his clothing will not interfere with the accuracy of the readings. Steel reflectors, turning slowly and silently give a uniform distribution of sound intensity throughout the room. The method consists of measuring the duration of the sound after the source has ceased in the sound chamber, and also in one of the test chambers, the two being separated by the test panel being tested.

The third view shows the plan of the laboratory, while the fourth gives the mechanical details of the sound insulation between the electrically-driven bellows and the organ.

WHERE SOUND WAVES ARE PUT ON THE OPERATING TABLE: SOME DETAILS OF THE WALLACE CLEMENT SABINE LABORATORY OF ACOUSTICS AT RIVERBANK



Instead of weaving the cords into a loose fabric by means of a widely spaced weft thread and then buttering rubber over the whole the cords are soaked in rubber milk and dried while in a position of perfect parallelism. The cords and the rubber become an integral mass and separation of the two which is the usual cause of a tire's downfall cannot occur while the stresses are perfectly distributed over all of the cords

A contrast between the old and the new methods of making cord tires

Sprayed Rubber

A New Hopkinson Process of Making Rubber which May Revolutionize the Rubber Industry

By A. G. Ingalls

A NEW process of making rubber, wholly different from that at present used in the rubber industry, much less expensive, altogether faster yet simpler threatens radically to change the entire process of rubber manufacture It is a dream of rubber chemists and physicists come true It represents years of research and grasping for a wholly new method of converting the solid content of the rubber milk into chemically as well as physically pure rubber in such a practical workable manner that the difficulties involved in the process at present used shall be done away with That method has been discovered *It has been tried* and found not wanting Not only that, but it makes better rubber than the older process—a stronger grade that is more enduring against age and more resistent to abrasion and wear

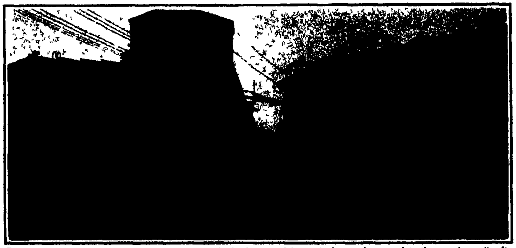
The new process is so utterly simple and so little involved with technical and cryptic lore that one wonders why it was not thought of long before But hind sight is easier than foresight while the greatness of simplicity is fundamental

In making rubber by the Hopkinson process the snow white rubber milk, known to the trade as latex arrives at the factory in tanks and is atomized by a simple centrifugal device Falling to the floor through a superheated atmosphere the spray is dried instantly making a miniature blizzard of filmy flakes and building up a drift of uniform textured uncontaminated cream colored, spongy rubber resembling baker's dough

Rubber is made in three ways The milky juice of the tree is coagulated on the paddle of the Amazon Indian Or it is coagulated on the plantations in pans by the addition of acetic acid and made into solid rubber in several stages, requiring the use of heavy rollers and several cleansing processes. Thirdly, it is made by the new latex spraying process. This process is fully controlled by patents owned by a prominent rubber manufacturing concern, but these patent rights probably will be leased to all other rubber makers who wish to use them

Annually in the world about 225,000,000 gallons of rubber latex or rubber milk is made up into about 250,000 tons of rubber Approximately ten per cent of this product comes from Brazil The rest comes from the Far East When we think of the source of the world's rubber supply we are quite apt to think of the damp, sodden silvas of central Brazil It is here that our schoolbooks told us rubber was produced by the native Indian who dipped his paddle into the white latex and held it in the smoke of a small open fire until the milk coagulated How the Indian of the Amazonas makes it still, but how the bulk of the rubber-growing industry has within recent years shifted to Malaysia, is an interesting story which has to be told, briefly, in order to prepare a background and to make more evident the contrasts with the new spraying process that has just been put on a practical working basis in the rubber world

Rubber comes from the juice of several varieties of trees, *but for practical purposes it will do to say that* Hevea brasiliensis is the tree that furnishes what we know as real rubber There are several other vegetable sources of rubber, or near rubber, such as the unrelated African bush that produces a rubber called by the trade "balata," and which is somewhat inferior Hevea brasiliensis grows wild in the tropics, especially in Brazil, but it has also been very successfully put under intensive cultivation in the Far East Scattered through the interminable and shadowy forests of the vast Amazon basin are found the millions of wild trees which are scarified by the forest Indian, permitting the juice to ooze out This juice is not the sap of the tree, for it has its sap in addition Rather it is a white exudation from the inner bark or bast, and is of about the consistency of country milk or city cream. It is not sticky No one tree gives more than a quart or two of latex, although many of the trees are large and it may with truth be said that the 225,000,000 gallons of latex gathered annually, including the part contributed by Brazil and Malaysia, is all collected, in the last analysis, by spoonfuls



The rubber latex is received from Sumatra in a tankship is pumped into a tankcar and conveyed to the spraying unit. It is pumped into a reserve tank in the upper room of the concrete structure and is sprayed through an opening in the floor into the chamber beneath where it meets with air heated to 500 degrees Fahrenheit. This dries the rubber milk instantly and it falls to the floor of the large empty chamber formed by the tapering portion of the peculiar structure in the form of rubber flakes. In the shed portion of the unit the accumulated rubber is weighed and baled Such a unit can turn out 600 pounds of sprayed rubber per hour and requires a crew of only four men to operate it

The spraying unit of the new Hopkinson process of converting rubber milk as received in tankships directly into rubber

Having gathered a container of rubber milk, the Amazon Indian builds a small fire using for this purpose the native urucuri nuts. When burned, these nuts give off the astringent fumes needed quickly to coagulate the latex Into the milky juice the native dips his canoe paddle and holds it in the smoke of the smouldering nuts, turning it continually as the thin coating of latex dries into rubber This process requires the driving off of about 60 per cent of the latex in the form of water vapor Again and again the paddle is dipped and smoked until finally a ball or "biscuit" about the size and shape of a large oval hornet's nest has been built up. The paddle is then removed from the center of the mass. Thus made, the biscuits are bought up from the natives by compradores who make their way into the wilderness to dicker with the Indian

Rubber made in the above manner is nearly black, owing to the smoking it gets. It usually contains other impurities in quite appreciable and annoying quantities, and as these quantities vary with each particular lot of biscuits and as the impurities may run from leaves and dead bark to sand and gravel, every separate lot of biscuits has to be treated differently before it enters the finished product, such as the tire you buy. Formerly the Indian found it easy to incorporate a few stones with the biscuit, adding to its weight without adding to the work. But the buyer has learned to cut each biscuit along an axis chosen by chance and the Indian has learned that the knife is too apt to meet with his padding of rock.

Plantation rubber could be grown in Brazil, provided the white man would be willing to die with fevers and provided the native could be prevailed upon to work after he had earned enough to buy him the few things he wants from civilization. But it is healthier for the white man in the Far East, and the native supply of labor, none too energetic, can be eked out by the Chinese who are found all over Malaysia and who are very intelligent and industrious. Moreover, rubber can be grown more cheaply in Malaysia than Brazil.

It may come as a surprise to some who well remember the geography lessons of their schooldays that nearly all of the world's rubber comes today not from Brazil, but from the Far East. The Amazonian continues to produce at about the same old rate, but the automobile tire industry has called for greater expansion than he could accomplish The Far East rubber is all grown on plantations in the Federated Malay States, Straits Settlements, Ceylon, Sumatra, Java, Borneo and Indo-China

The rubber of Malaysia is treated by the coagulation process. This process has nothing in common with the process of the Indian and his smoky fire. Neither is a large proportion of our rub-

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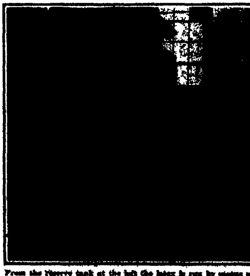


From the reserve tank at the left the latex is run by means of a hose through an opening in the floor at the bottom of a conical depression shown in the illustration. Here it meets an aluminum disc revolving at 4000 R. P. M. in the drying chamber below and is whirled into thin spray in hot air from the brick furnace shown in the background. A spare motor and spraying disc hang in readiness from a hoist. The dials are those of thermographs for controlling the heat of the air for drying.

Interior of upper portion of the spraying unit, showing the spraying and air-heating apparatus

New type of lake and coastwise vessel of 2600 tons, designed to pass through the State Barge Canal

Sea-Going Ships for the State Barge Canal

Special Type of Barge Designed for Combined Lake, Canal, and Ocean Traffic

DURING the war we illustrated a new type of vessel, combining the qualities of a barge with those of an ocean-going ship, designed by Mr McDougall, a veteran of lake transportation, which was intended to carry freight through the Great Lakes and the State Barge Canal to the Atlantic Seaboard, and thence to such coastwise or foreign ports as might be desired. This first experimental ship was taken up by the Government and gave good service during the war With the experience gained with this experimental vessel, Henry Penton of Cleveland, in collaboration with A. Miller McDougall, designed two improved ships of the same type, which are now being built at Detroit These vessels are designed for operation through the Great Lakes and Welland Canal and the New York State Barge Canal via Oswego and the Hudson River, to New York and points along the coast. They are of full Welland Canal dimensions, with a length of 258 feet and a beam of 42 feet and a depth of 19 feet, and they are being built to meet the requirements of the highest class of the American Bureau of Shipping for Great Lakes and coastwise trade. Their service will cover the trade to the West Indies, the Gulf of Mexico and the Caribbean When using the State Barge Canal, the ships will be loaded to a draft corresponding to a deadweight capacity of about 2000 tons, and at sea the capacity will be about 2600 tons. The ships have a full-length, double bottom, with stowage for fuel oil and water ballast.

The vessels will be propelled by the electric drive, and the unusual feature is the system of control of propulsion units. The gas engine will operate generators, whose current will be carried to electric motors, one on each shaft, which will be controlled entirely from the Pilot House, both as to speed and direction, by means of controllers under the hand of the officer on watch on the bridge. The main engines will run continuously in one direction at one speed. They will not be reversed or manœuvered, in fact the engine room force takes no part in the handling of the ship. This arrangement gives extreme flexibility as well as centralization of control There is the added advantage of the elimination of the racing of the propellers in heavy water.

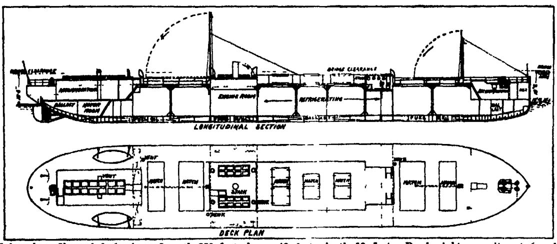
The propelling machinery is of the Diesel-electric type, in which two six-cylinder engines are coupled to electric generators as described above. In addition to supplying the main propeller motors, the generator also supplies current for the auxiliary machinery, such as pumps, windlasses, capstans, steering gear, refrigerating machinery, fans, lighting, etc. The living quarters are heated electrically; the galley range is of the electric type; the water for bath and other purposes is electrically heated, even the whistle is operated by a motor instead of by steam or compressed air

Refrigerated space is provided in two holds for about 600 tons of perishable cargo, the refrigerating machine, being in multiple, to facilitate control of temperatures as well as a measure of precaution against failure A duplicate system of fans and ducts circulates air through chambers containing coils of pipe, through which brine at a very low temperature is pumped, the chilled air being thence driven into and through the refrigerator holds. Perishable cargo such as dairy products, for example, can thus be maintained at proper temperatures at all times and delivered at destination in perfect condition. The advantages of this arrangement, as compared with rail shipments with slow movement and frequent delays, will be apparent.

Commodious quarters are provided for the crew The master, mates and deck crew are berthed forward, and the engineers, oilers and stewards aft, with baths and toilets for all. There is a three-berth hospital and a fresh water supply has been installed in conjunction with the officials of the Public Health Service As a safeguard against contamination the supplies for drinking and cooking are drawn only from certified sources and they are entirely separate from the ablutionary supply

The clearance between the surface of the canal and the underside of the lowest bridge structure throughout the canal is only 15 feet 6 inches—a fact which accounts for the absence of permanent masts and deck super-structures on these two vessels The two masts shown are hinged at the deck and can be quickly lowered The smokestack and ventilators also are hinged and can be similarly lowered when passing under bridges.

Conservative shipping men, discussing the possibility of using ships of the Great Lakes for deep sea service, have declared that the thing cannot be done, for the reason that dimensions, proportions and scantling that are suitable for service on the lakes, produce a ship which is not suited for coastwise and trans-ocean service. Although we agree that a ship built especially for lake service is by no means an ideal ship for deep sea work, we have always believed that it would be possible to build a special type, which, structurally would have the necessary strength for both services and at the same time would operate under no serious economic handicaps, either in the lakes or on the ocean



Inboard profile and deck plan. Length 258 feet; beam 42 feet, depth 19 feet Deadweight capacity at Canal draft, 2000 tons at full sea draft. Masts and smokestacks can be lowered in the Canal

Are Bees Color Blind?

WHAT effect has color on bees and are these industrious insects able to distinguish between various colors? This question has been investigated a number of times. The importance of the problem may not be evident at first glance, but it is possible that the ability of the bee to distinguish between different colors may have a significant bearing on the attraction that flowers have for it. This again may influence on the production of honey in a particular apiary, for unless the flowers were of the proper colors, the bees would not seek them out and gather the honey contained in them

The bees were allowed to become accustomed to a certain color in such a manner that it indicated to them the food kept in small cups, which were arranged on paper of definite colors Gray papers of different degrees of brightness, which must exert the same stimulus on the color blind eye as colored papers, were used in the experiments for comparative purposes. In order to exclude the sense of smell, the papers were changed frequently or they were covered with glass plates. Furthermore, in order that the sense of location should not be allowed to influence the bee in conducting him to the place where the food was stored, the position of the papers was changed from time to time In the experiments colored papers, dyed with pigment colors, colors extending over quite a range of wave lengths were used In order to avoid errors which might possibly result in the experiments, monochromatic light was used

This was done by casting a mercury spectrum on the paper from which all the colors with the exception of a single one were screened off The position of the same on the experimental table was repeatedly changed The bees were allowed to become accustomed to this one color Then the entire spectrum was thrown on the paper and the bees were permitted to discover therefrom the particular color which they had been originally broken in to

It was found that the bees were able to distinguish easily and clearly violet up to blue and from green to yellow Ultra-violet was also distinguished The conclusion was reached that bees were able to recognize the colors in quite a wide range of the spectrum In a recent issue we dealt with the color blind aspects of several animals.

Our Point of View

Politics in Engineering

ALWAYS it is a source of relief to engineers when the practice of their calling is unhampered by the politician. Engineering is so serious and exact a profession that its members have no time, and less inclination, for that grotesque and unstable thing which we call politics. The study of physics and mathematics at college, followed by the construction of bridges, earth works, power-plants and machinery in its multiplied forms, serves to cultivate in the qualified engineer a perfect passion for cold facts, close reasoning, and straight forward procedure. The ethics of his profession, and its practice, beget in him a wholesome distaste for the shams and uncertainties of a political life. So far as the politician is concerned, the engineer asks only to be let alone, so that he may put the very best of his knowledge and experiences into the prosecution of his work.

Hence it is that the recent removal of Mr Arthur P Davis from the position of Director of the United States Reclamation Service has produced positive consternation among the members of the engineering profession, for Mr Davis is an engineer of high standing, who for an unbroken period of forty years has proved himself to be an accepted and highly capable servant of the Government. Step by step his knowledge and abilities had raised him to the position of the executive of one of the most important governmental engineering enterprises in the United States. He was removed peremptorily. No adequate explanation has been given for the change, nor has he been afforded an opportunity for defense. His removal takes on a strong color of partisan politics. Not only is the unseemly precipitation with which this distinguished and well proven servant of the public has been dismissed a matter of profound discouragement to the engineers of the country, but the reason which is given for the change is even more so.

The Secretary of the Interior gives as an explanation—if it can be called an explanation—that he wishes to place this great public work in charge of a business man rather than of an engineer, and without showing wherein engineering control has failed, he merely abolishes the office of Director, and creates in its place the office of Commissioner. This is mere quibble. Our leading engineers have ever been distinguished by great business and administrative ability. But so it comes about that one of the most distinguished and successful of the world's engineers in great works of reclamation gives way to a country banker who, we understand has also been a Governor of Idaho. The whole affair is at once discreditable and discouraging, discreditable, because it betrays a great lack of courtesy, and discouraging, because it is a conspicuous instance of a movement to transfer the control of engineering works from practical engineers and place it in the hands of the politicians. The SCIENTIFIC AMERICAN has always contended that the interests of the country can best be served by placing engineering works under the control of engineers and removing them, as far as possible, from the baneful influence of the politicians, for these have almost invariably looked upon the responsible positions in such work as so many plums to be given to faithful followers of the party.

The attitude of the average politician to the engineer, and to all technical men for that matter, is one of contempt for the expert. This spirit is more often than not an expression of jealousy and dislike of the man who does not know for the man who does know. Residents of New York will not soon forget the contemptuous references of our distinguished Mayor to "those experts", and although such an attitude has no part, surely, in the motives which prompted the elimination of Mr Davis, the Secretary of the Interior cannot blame the intelligent element among the American people if they believe that this automatic elimination of an able executive from a great public work has been prompted by political motives of the most pronounced kind.

A World Timber Famine

IN A recent letter to the President of the Chamber of Commerce of the United States, the President of the American Tree Association, Mr C. L. Pack, draws attention to the warning of a world timber famine, which is given in the annual report of the British Forestry Commission. General Lovat, Chairman of this committee, is coming to the United States and Canada to ascertain what future timber supplies Great Britain may expect from North America. In his letter to the United States Chamber of Commerce, Mr Pack states that the threat of a timber famine affects not alone the British Isles but the whole world. The British forestry report states that there exists a widespread apprehension of a timber famine in the United Kingdom at no distant date. The demand for timber is constantly increasing and the virgin forests are being worked out far more rapidly than was expected. Hence, the committee wishes to ascertain what reserves of coniferous timber are available for import and how long they are likely to last.

It is evident that the question of the United States timber supply is a serious one not only for us but for Europe. In a recent article on "American Individualism and European Recovery," it was stated that during the years 1913 to 1923 the ton miles of service in the transportation industry increased from 166,000 per worker to 240,000. To keep industry going, it is estimated that 5,000,000 trees are cut down every year, merely to provide the poles to carry the wires over which pass the messages of industry, and that 200,000,000 cubic feet of wood are consumed every year in mining and quarrying. These two items represent vast quantities, but they cover only a part of the field. We must add to them the enormous demands of the railroads for ties and structural material, and of the building trades for the construction of homes and factories. Another terrible source of loss, which annually cuts deeply into our forest reserves, is fire, which during a recent five-year period was responsible for the wiping out of no less than 56,000,000 acres of forest lands.

The conditions stated above are sufficient corroboration of the statement that, unless every possible effort in the shape of protective legislation and extensive reforestation is made, not merely Europe, but the United States itself, will ultimately be brought face to face with a timber famine. Were the annual consumption a constant amount the situation would be serious, but because of the rapid growth of population, particularly in the United States, and the equally rapid expansion of industry, the consumption of timber shows an annual increase. These warnings of the American Tree Association are no mere cry of "wolf, wolf!" The menace is only too real, and it approaches at an ever-accelerating pace.

Bombing United States Battleships

AN ATTEMPT will be made this summer by the Army Air Service to demonstrate that battleships can be sunk by bombing machines operating as closely as possible under war conditions. The Navy has turned over to the Army Air Service the two pre-dreadnaught battleships "Virginia" and "New Jersey," which, it will be remembered, are among those whose destruction is called for in the Washington Treaty of Limitation.

Criticism was made of the sinking of the "Ostfriesland" two years ago, on the ground that the vessel was stationary and, therefore, presented an ideal target. In the present operations, the battleships are to be towed, and although their speed will not approach the modern battle line speed of seventeen to twenty-one knots, the targets will be towed at several knots' speed and the difficulty of registering a hit will be proportionately increased. On the other hand, there will be no defense by anti-aircraft gun fire. To compensate in some measure for this the bombing planes should fly at a height of several thousand feet. Special interest will be attached to this experiment because the first use will be made of a new 4300-pound bomb containing 2000 pounds of T. N. T. So far as we know, this is the largest bomb that has ever been constructed. The aviators will attempt to drop it alongside the ship and set the fuses so that detonation will take place fifteen or twenty feet below the surface. If they succeed in doing this, there is no question that a large area of the side of these old battleships will be blown in and their sinking will be a matter of a few minutes.

Judging by their power of resistance to these Brobdingnagian depth charges (for such they are) the "Virginia" and "New Jersey," being ships of earlier design, will be easier to put down than was the "Ostfriesland." The "Virginia" and "New Jersey" were laid down in 1902, or some years before the dreadnaught period. The "Ostfriesland" was not laid down until 1908 and great attention was paid to her underwater design, particularly with a view to preserving her flotation in case of injury by torpedo. The test, therefore, will be more a test of the skill of the airmen than of the resistance of the ships. We are of the opinion that if one of these 4300-ton bombs were detonated ten feet from the side of the "Maryland" and twenty-five feet below water, even that great ship, in spite of her elaborate subdivision and the provision of gas-expansion chambers, would succumb to the attack.

Dams Versus Droughts

ONE of our busiest industrial centers is to be found along the upper Hudson River, upon whose banks are paper mills, power plants and various industries, all of which derive their power from the flow of the river. Like all streams which head in the mountains and elevated up-lands, the flow of the Hudson is very variable. During periods of high water, the manufacturers see billions of gallons of water flowing by to waste, whereas in the dry season the river becomes so low that many of the mills have to be shut down and thousands of employees thrown out of work. For nearly fifty years past both the State and various private agencies have been considering the advisability of storing up the flood waters and passing them down, gradually, during the dry season. Not only would such a plan prevent the periodical closing of certain factories, but it would result in the saving of some 2,000,000 tons of coal a year, which have to be burned during periods of low water to keep the larger and more important industries and power plants going. During the past half century many investigations have been made of this problem, and at last a scheme has been drawn up by E. H. Sargent, Engineer for the Board of the Hudson River Regulating District, a body created by the Legislature of 1921. The plan calls for the construction of sixteen storage reservoirs in the upper Hudson River watershed with a combined capacity of five hundred and ninety-three billion gallons. The execution of the work would take twenty years and its total cost would be $30,000,000. Money is to be raised by assessing the communities and industries that would be benefited, and fifty-year bonds backed by these communities and interests are to be issued. The plants to be affected can develop at present a hydro-electric energy of 180,000 horsepower; but because of the droughts their continuous average output is only 85,000 horsepower. When the scheme is completed, the engineers claim that the flow of water in the river will be continuous and that 140,000 horsepower can be realized in these plants throughout the year.

It is one of the advantages of such reclamation schemes that the damage done by freshets will be eliminated. The most severe flood in the history of the Hudson River was that of March 28 and 29, 1913, when the flow was over 200,000 cubic feet a second at Albany and about $1,000,000 worth of damage was done to various towns along the river. If the largest of the sixteen reservoirs (that at Sacandaga) had been in existence, it is estimated that the peak of the flood could have been controlled sufficiently to prevent this damage.

Our Point of View

The Facts as to German Submarines

THE Navy Department announces that it has received an authentic official report covering the facts regarding German submarines constructed and lost during the war It represents some four years of work in checking official records and consulting various members of the German Admiralty In the first place, as to the total number of U boats built by the Germans during the war, the books of shipbuilding firms holding contracts show that 281 submarines had been delivered and 197 were under construction when the Armistice was signed. As to what became of all these and the men who manned them, we learn that the losses in personnel were 5364, of whom 515 were officers. Of the submarines, 37 were accounted for by depth charges, 36 by fixed mines, 20 were lost in fights with enemy submarines, engine and other troubles accounted for 14, destroyers, torpedo-boats and sub-chasers sank 13, 8 were lost through accidental ramming, armed fishing craft accounted for 6, aerial bombing for 6, and 6 were lost in submarine nets. In addition to the above, 21 U boats were demolished to prevent their capture by the enemy

A study of the chart accompanying the report provides us with the geographical distribution of the losses, and we find that 56 boats were lost in the English Channel, 26 in the North Sea, 16 off the eastern coast of England, 16 were lost in various parts of the Mediterranean, 12 off the Dutch coast, 8 near Heligoland, 2 in Scapa Flow and the remainder at widely separated points on the seven seas. The location of the losses as given above is about what the daily record of the war in the press would lead us to expect The toll of ships to be credited to the various enemies of the U boats is something of a surprise Thirty-seven boats destroyed by depth charges is about what one would look for, but that a nearly equal number were destroyed by fixed mines is surprising If we remember correctly, seven to ten of these were credited to the great sea barrage of mines stretching from Scotland to Norway Another surprise is that 20 submarines were lost in encounters with enemy submarines. It would be very interesting to know the particulars of these encounters, whether they took place below or above the surface, and whether the losses were due to gunfire, torpedo or ramming We take it that the 13 U boats destroyed by torpedo-boat destroyers and sub-chasers and those destroyed by depth charges should go together, in which case fast surface craft accounted for about 50 of the total of U boats destroyed. If so, this establishes the claim of naval men during and since the war, that the most effective answer to the submarine is a fast destroyer carrying a heavy battery and a large supply of depth charges.

Super-Pressures in Steam Plants

IT WAS not so long ago that a pressure of 200 pounds per square inch at the boiler was considered to be the maximum under which a power plant could satisfactorily be operated. High pressures brought with them difficulties in the way of leaking joints, etc, and the quality of the material which was then available for steam piping, cylinders, etc., set a limit upon the use of extremely high pressures. The last two decades have seen a great development in the production of high grade iron and steel, and materials have become available which, because of their strength and reliability, have encouraged steam engineers to run their boilers under increasing pressures. If you look at a list of the great power plants of this country today you will find that a boiler pressure of 200 pounds is comparatively rare, and that the later the date of completion of a plant the higher is the pressure employed. As to those under construction, the pressures run from 265 to 375 and 400 pounds, and there are two power plants of large capacity under construction which will use the high pressure of 550 pounds per square inch.

The objects aimed at in this movement are to secure a high thermodynamic efficiency and to secure that reduction in the dimensions of the turbines and steam piping which the great density of the high-pressure steam makes possible That the steam engineers of the country are well satisfied with the results secured is proved by the action of an electric light and power company in Boston, where they are about to install a turbine plant in which the boiler pressure is to be not less than 1200 pounds per square inch

As if this were not sufficient, we learn from *Engineering* that there is being built for the Willans Works at Rugby, England a steam turbine whose boiler will be operated under the amazing pressure of 3200 pounds per square inch. Commenting upon this courageous venture, our contemporary draws attention to the interesting fact that, since, as the pressure rises the steam becomes denser, and the water, on the other hand, less dense owing to its expansion by heat, there must come a point where the steam and water will arrive at a state of equal pressure, temperature and density, or to put it another way they will become indistinguishable from one another This point is reached at a pressure of 3158 pounds per square inch and a corresponding temperature of 705 degrees Fahrenheit At this point, also the water can be changed to steam without any surface of separation The containing vessel may be solidly filled with water under this high pressure and temperature, since it becomes steam throughout its mass when the temperature is sufficiently high The cycle of operation of the Rugby plant as calculated by Professor Callendar is as follows

At a pressure of 3200 pounds per square inch and a temperature of 706 degrees Fahrenheit the volume will be 0 052 cubic feet per pound and the heat required is 820 British thermal units per pound The steam is throttled down to 1500 pounds absolute and a corresponding temperature of 596 degrees Fahrenheit It is then heated at 1500 pounds to 700 degrees Fahrenheit The steam is then expanded adiabatically in a high-pressure turbine to a pressure of 250 pounds The steam is next reheated at 250 pounds to 700 degrees Fahrenheit, and then expanded in a second turbine down to a vacuum of 28 inches The heat available for work in the two turbines is 571 B t u and the total heat supplied is 1471 B t u, giving a total over-all efficiency of about 38.8 per cent The operation of the Benson turbine, so named after its inventor, will be followed with close interest by steam engineers.

Decline in World's Shipbuilding

THE dislocation of the shipbuilding industry by the war left the merchant marine of all countries in such a state of unstable equilibrium that even today, nearly five years after the close of the war, the situation is very confused. The enormous increase in the output of the shipbuilding yards, particularly in the United States, carried the world's total of shipbuilding to a point far above the demands for cargo space, even in normal times. Except in this country, where the shipbuilders decided to complete their vast building program, there was a more or less severe slump in building activities, and for the past few years the shipbuilding yards of the world have been in a rather bad way

The last report of Lloyd's Register of Shipping covering the quarter ending June 30, shows that on that date the shipping yards of the world had a total of 2,250,000 gross tons of work, which is a decline of 300,000 tons below the figure for the previous quarter The statistics of new construction show that Great Britain and Ireland lead with 1,338,000 tons, then in their order follow Germany, 352,400 tons, France, 179,000 tons, Italy, 141,500 tons, United States, 133,700 tons, Holland, 100,000 tons, Japan, 72,800 tons, and British Dominions, 45,000 tons. It will be noted that Germany holds the second place among the shipbuilding countries and that she is building twice as much new tonnage as her next competitor, France. This was to be expected because of the great depreciation of the German merchant fleet, by the handing over of the largest and choicest part of it to the Allies as part of her reparations.

Comparing the above figures with those for the last quarter of 1914 prior to the war, we find that the United States yards were building 15,000 tons less during the last quarter of the present year and the British yards about 400 000 tons less. Since shipbuilding affords a reliable index to world prosperity, it is evident that there is a long way to go before industrial equilibrium is again restored.

Seventy-five Years Ago

FROM the earliest days of railroad travel, the question of high speed has excited the public interest Thus in our issue of September 9, 1848, it is recorded that a new engine, with 5-foot 6-inch driving wheels, pulled a train of five passenger cars carrying 250 passengers from Springfield to Hartford at the rate of 50 miles an hour, "the quickest trip ever made in this country with a heavy train over any railroad" Those were the days when English locomotive builders were in favor of large-diameter driving wheels for fast trains, and the Editor suggests that with larger wheels a speed of 50 to 60 miles an hour could be obtained Our builders made the experiment, but soon returned to the 5-foot 6-inch driving wheel, which remained the standard size for 30 years or more

That 75 years is sufficient to carry us back to the beginning of things is realized when we read as follows "The City of Providence is taking measures to light its streets with gas The Almy Gas Light Company have commenced laying pipes and putting up fixtures. The place having been heretofore badly lighted, the inhabitants evinced great joy at the new way of illumination"

And while on the subject of modest beginnings, take note of the following "Very few railroads in this country can show greater percentage of increase in their receipts of the last six months than the Macon & Western Railroad of Georgia From a statement just published, it appears that the total receipts for August, 1848, were $12,476 and August, 1847, $9,441"

The August editorial page opens with an announcement of the discovery of an immense bed of gold, 100 miles in extent, on the Fork and Feathers River, California The gold is recovered by "washing out the sand, in any vessel from a tea saucer to a warming pan" The American settlements were deserted, we are told, farming nearly suspended, ships lost both their sailors and captains, and not even $10 a day would tempt laborers to return to the farms." All of which, by the way, sounds very modern

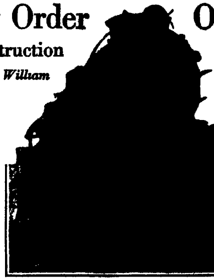
How many of our readers are aware that the United States Navy, 75 years ago, made a survey of the River Jordan and the Dead Sea. As told by Lieutenant Maury, the story reads like a romance Two metallic boats, one of copper and the other of iron, were transported over the mountains and launched on the Sea of Galilee Galilee was navigated and a survey of its bottom made The deepest sounding made was 1128 feet There is nothing that the Navy cannot do. Well might the Editor exclaim "It is a specimen of the skilled system and discipline of the American Navy"

Very interesting is a letter in the September issue from Elias Howe, Jr, of sewing machine fame, dated from London, which opens thus "I am in the regular receipt of your valuable paper (through my father in Cambridge, Mass.)," and goes on to give particulars of a French sewing machine which had appeared in an earlier issue The letter proceeds "I wish to say to your correspondent that I expect soon to submit a sewing machine which will stitch and sew in the same manner as is done by hand " Howe had just secured a patent in London to which he refers by saying that "John Bull is thick upon some matters, and upon that seal is decidedly thick"

Bringing Order Out of Chaos

The Emergency Job of Reconstruction after Philadelphia's Station Fire

By William A. McGarry



After the blaze—a locomotive delicately balanced across a girder

PROBABLY without parallel for sheer speed in peace-time experience was the engineering feat accomplished recently at Broad Street Station Philadelphia. Passengers in and out of that terminal of the Pennsylvania Railroad look up today at the vanishing remains of a rusted fire-blackened steel skeleton that once supported the largest arched train shed roof in the United States. They see little figures of men swarming about with oxy-acetylene torches 150 feet in the air to cut away the twisted girders, cranes dropping them to flat cars and the latter moving in and out with no interruption to the regular train service. They probably marvel at the efficiency of a system that can run a train a minute under such circumstances. But the task today is relatively simple compared to what was done in three days after the train shed burned down.

Broad Street Station stands at the juncture of West Penn Square and Market Street. The Pennsylvania main lines run directly west from there on an elevated structure paralleling Market Street. Fifteenth Street is crossed by girders carrying the passenger platform just outside the gates; the elevated structure is carried over all other cross streets by brick arches. The station office building is a seven- to ten-story brick structure occupying the space between Penn Square and Fifteenth Street.

Virtually all the space under the elevated structure between the cross streets is utilized by the railroad or allied services. The surface of the road was carried within the shed on ties set in concrete which rested in turn on a girder system. When that was built 26 years ago it was quite adequate to carry the rolling stock then in use. But as equipment became heavier the company found it necessary from time to time to strengthen the supports of the tracks. To that end steel and wooden uprights and girders had been put under the old work. Beneath the concrete of the train floor was six feet of this heavy wood work boxed in from below by the ceilings of storehouses, engine rooms, a post office sub-station, baggage rooms, etc.

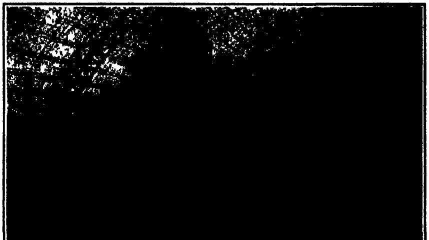
Likewise although the roof appeared to be of steel and glass there was quite a bit of timber in it and much tar paper and similarly inflammable material. The fire started at 11.45 p. m. on Sunday, June 10th with a trickle of smoke under the platform between tracks 11 and 12 and at first it seemed a simple task for the station firemen to check it. Within five minutes however they had discovered that the blaze had gone down into the garret-like area below the tracks and within an hour 25 city fire-fighting companies had arrived and all the apparatus in the city had been shifted. By that time the burning of wires had disrupted telegraph, telephone, signal and train starting systems, and fire in the engine rooms had put out of service the air compressors for the operation of the switches and nearly every other phase of the terminal system. The fire swept the whole length and breadth of the great shed in the area beneath the tracks and over the surface platforms crawled up the steel and brick walls and shot hundreds of feet in the air as it licked its way across the acres of glass above.

The interior of the shed was obviously untenable for human life with smoke, flame and melting glass. But somehow railroad workers operating in the most complicated system of tracks in the world got into that shed with switching engines often enough to drag out a string of sleepers bound for Boston and filled with slumbering passengers, most of whom knew nothing of the fire until they arrived in the Hub the next morning. They also saved all but 21 passenger coaches and three locomotives. In the meantime the fire had jumped a hundred feet over Market Street to the upper floors of a steel skeleton which is to be a theater and office building and burned out six floors of timber forms for concrete.

At that time when experienced firemen were beginning to talk of dynamite to prevent a possible city wide conflagration, when fire crews had been called out by a dozen skyscrapers and when the station itself seemed doomed the work of reconstruction started. Over borrowed circuits calls began to go out for division engineers, supervisors, master carpenters, trainmasters and all sorts of technical experts, also for section gangs and common labor. Heads of employment agencies and supply houses were routed out of bed at three o'clock to take orders for men and materials.

The first actual work, of course, was the removal of debris. Shifting crews and section gangs became "smoke eaters" to do that, handling red hot materials with all sorts of improvised tongs at the very edge of the burning area, tearing up platforms still burning and otherwise making way for new construction. In the meantime other forces were preparing new schedules to use improvised stations in various quarters of the city for the handling of passengers over the commuting lines.

By daybreak a group of men out beyond the fire area near Seventeenth Street had gone to work on the brick retaining walls overlooking Market Street on one side and Filbert Street on the other. In a short time it became evident they were constructing temporary stairways. At about the same time shifting engines began to crawl over the network of tracks with loads of cinders and timber, and a growing force of carpenters got to work laying platforms right up to the edge of the burned section. Another gang wearing asbestos gloves started stripping everything loose from the train-shed roof. In spite of the new fire raging underneath, platforms of some kind were shoved up to the train gates so that even on Monday the company operated 78 trains in and out of Broad Street Station.



General view of the wreckage in the Pennsylvania Terminal in Philadelphia, with the electricians patching up the nerves of the train-control system

The rate of progress after that may best be indicated by the number of trains operated. It should be borne in mind that the second fire burning underneath the shed was at its worst on Monday afternoon, completing the destruction of wires, compressed air and similar services. On Tuesday, however, 142 trains ran in and out. On Wednesday 151 were handled. Thursday enough tracks had been straightened out to run 245, and on Friday and Saturday 275 trains were cared for in the ruined station. In just nine days all sixteen tracks were restored and ready for service, and 309 of the 530 trains normally operated out of the terminal were running on regular schedule. It was not possible to bring in the others because it was necessary to use from four to six tracks for the reconstruction work.

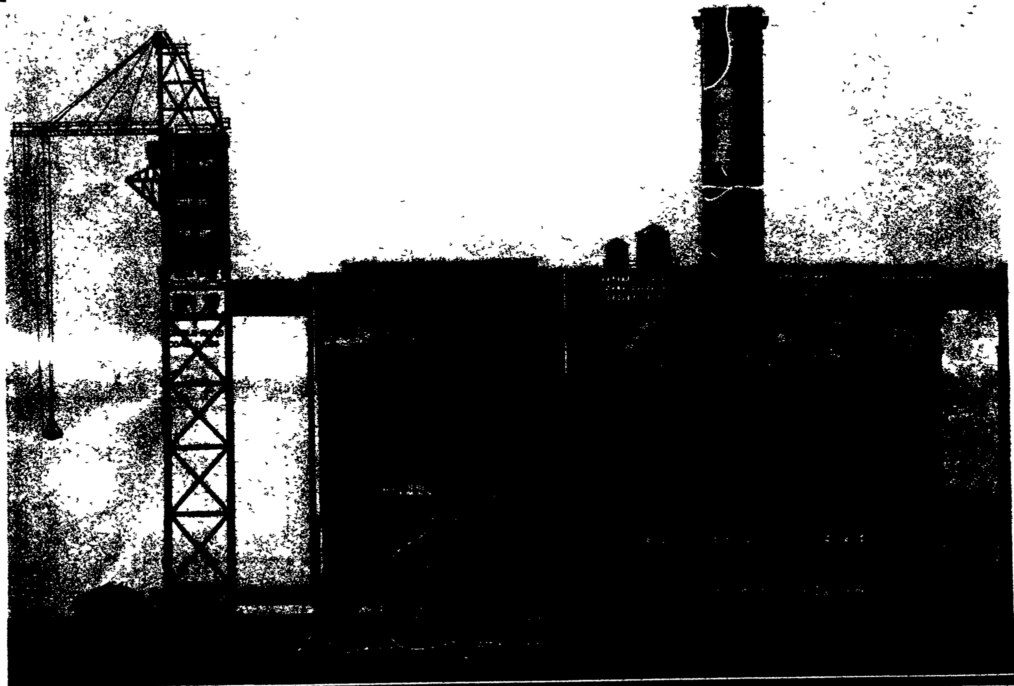
More than 1400 men were employed on day and night shifts Monday, and that number was increased to nearly 3600 three days later, when the worst of the emergency task was concluded. All that has been described, however, was more or less simple compared to the accomplishment underneath the train floor in which every phase of engineering was brought into play.

Before a single train could be run up to the gates it was necessary to replace the destroyed support timbers. By the time the smoke had been cleared out of the shed it was found that one locomotive had fallen partly through the concrete floor, bringing up in precarious balance across a few partly burned girders. The floor was not strong enough even for the electric suburban equipment.

Early on Monday morning the lumber yards were delivering timbers into the side streets just beyond the danger area, and before noon a half dozen portable sawmills arrived. It was not then possible to invade the whole area underneath, but men managed to get into partly cooled and burned-out sections in order to shore up a track or two. After them—or rather with them—went the electricians. In some instances they succeeded in forestalling the fire cutting into cables out on the line and carrying emergency loops into the station. The railroad owns the property paralleling its line on the north, and over the tops of these were strung by daybreak more than 400 pairs. As soon as the ruins had cooled enough these were bunched and carried through windows into the terminal room.

A list of the electrical work would read like a catalog. Suffice it to say that in seventy hours after the first fire started the train starting system was reestablished with indicators on all the tracks, the telephone and telegraph lines temporarily shifted to West Philadelphia were operating out of the main offices in Broad Street, and all the other complex parts of the system were in working order in so far as wires were concerned. The power restoration was just as rapid. It should be stated that the railroad runs commuters' trains on two of its most heavily traveled lines by electricity. For the convenient handling of these trains every track of the sixteen in the train shed had an overhead trolley wire, and naturally all of these came down, together with much of the side supports. Workmen restored them first on temporary supports, a foot at a time, following the smoke, and later put in more permanent stanchions.

The story of how the old train shed is being removed is also of interest. It stood a gaunt and twisted skeleton after all the flames had been extinguished and officials had long realized that it could not be restored. Plans were drawn for a traveling platform to operate on four tracks, with clearage of passenger trains and of the umbrella sheds which are to be built over the platforms between tracks. The main wheels of the platform run on tracks 7 and 10. Tracks 8 and 9 are being used to load and haul away the steel work, and the outer ends of the platform or apron are carried on tracks 1 and 16. On the platform are derrick booms and other equipment to bring down the steel after it is cut. It is estimated that every vestige of the fire interfering with passenger traffic will have been removed within eight weeks of the day it ended, long before which time all the umbrella sheds will have been completed along with the other reconstruction work.



THE coal for this power plant is received in barges and unloaded by means of bucket hoists. The bucket hoists deliver the coal to the hopper in one of the two coal towers, whence it passes down by gravity through the coal crushers and into the cable-road coal cars below.

The cable-road coal cars operate automatically. When filled, they move along through the cable gallery to the coal bunkers, where they automatically empty their load and return again to the coal hopper. Also, a certain quantity of coal is sent to the storage yard, not shown here, which has a storage capacity of 100,000 tons.

From the coal bunkers, which have a total capacity of 2800 tons, the crushed coal passes down to the traveling coal larry, which in turn carries the coal down its aisle in the boiler room, to the various automatic stokers of the boilers.

The crushed coal gives an intense heat in the boilers, under the forced draft. It is steadily fed by the automatic stokers, while the ashes are automatically and continuously removed at the bottom and dropped into a hydraulic sluicing system so as to be carried out in a stream of water to a reclaiming basin outside, for subsequent removal by barge and truck.

The high-pressure steam of the boilers drives the turbo-generators. Contrary to usual practice, the generating end is placed nearest the river because the circulating water system is materially simplified thereby. The circulating water system serves to condense the exhaust steam.

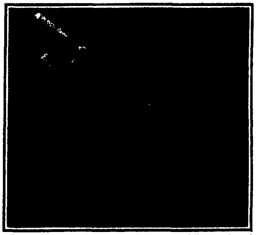
The distributing or current-handling end of the station is placed in a separate building at the right, not shown.

CONVERTING THE LUMP OF COAL INTO ELECTRIC POWER AND LIGHT: NEW YORK'S HELL GATE STATION, REPRESENTING THE LAST WORD IN GENERATING PRACTICE

Sixteen-to-One Automobile Testing

Extraordinary Assembly of Apparatus for Making Many Tests on a Single Run of a Motor Car

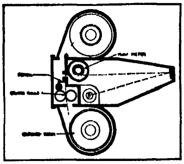
By S. R. Winters



The Bureau of Standards test automobile, equipped for sixteen simultaneous determinations of important features of gasoline performance and car economy

THE automobile engine may be tested in the laboratory, under ideal conditions, but it must run on the road under conditions far from ideal. When traveling along the highway at a speed of forty miles per hour, more or less, the behavior of car and engine presents so many aspects that, for their competent observation, more observers would be *required than could possibly be packed aboard the car.* It is in this emergency that the inventive faculty is called into play, the Bureau of Standards has recently devised an apparatus that automatically and autographically records the action of the car, in sixteen separate particulars, requiring at most the attention of one or two operators in addition to the driver. This makes it possible to conduct road tests on a basis never before dreamed of, as regards both accuracy and completeness.

The rate of flow of gasoline in an automotive engine is an index to the rate of energy input. Obviously, then, the first object was to find a suitable instrument for determining the flow of the gasoline. A flow meter was selected comprised of a vertical tube slotted parallel to its axis. A light piston moves vertically in the tube. Gasoline enters the latter at the bottom, flowing freely out of the slot below the piston into a ring-shaped space through which the position of the piston may be seen. The pointer affixed to the piston, moving over a vertical scale on the central tube, indicates the effective length of the slot. Knowing this, and knowing the pressure, the rate is indicated.



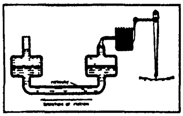
The mechanism of the flow-meter camera

Preliminary experiments involved the use of photographic records secured by focusing an image of the scale and pointer of the flow-meter on a moving film. The bulkiness of this type of flow-meter camera operated to a disadvantage, and the design was displaced by one in which the camera traces lines of the scale and pointer by means of shadows on a roll of bromide paper. Time intervals are controlled from a contact mounted on the tachometer of the car, and these are impressed on the fuel-flow film by the alternating increase and decrease in the intensity of the illumination on the bromide or sensitised paper.

How much energy or thrust does it require to move an automobile on a level highway, down hill, or up-grade? The apparatus described replied to this question in terms of the power output of the engine. An accelerometer was employed, which is essentially an instrument for measuring the force acting on a "free body" to supply the latter with the constant increased velocity which is to be accurately determined. Such a device appraises the linear acceleration, positive or negative, of the automobile mass, and takes account both of the velocity and of the gravitation factor.

The "free body" employed in the particular accelerometer used in these experiments consisted of a column of mercury mounted parallel to the wheel base of the motorized vehicle. The gage element, an abbreviated connecting tube, as well as the space above the closed end of the mercury column, were filled with a light oil. When the tube containing the mercury column is acted upon by an increased velocity parallel to its long axis, a hydrostatic pressure is exerted in the oil, thus balancing the force required to accelerate the mercury. This pressure is recorded by a pen-arm affixed to the compression element. Oil is an agent of pressure transmittal which not only minimizes the motion of the mercury but reduces the lag of time in the instrument.

Automotive engineers are familiar with the formula relating to the operation of an automobile, namely, that the engine power at the clutch required to propel the vehicle is the aggregate power needed to overcome half a dozen counter forces. First, *of course, is the force*—measured as the product of the mass and its linear acceleration—necessary to overcome the inertia of the car. Then we have the mechanical friction losses—that is, the energy squandered in the transmission, universal, differential, rear axles, and wheel bearings, the tire-rolling losses, the energy consumed in overcoming windage, that employed to fight the gravitational pull in climbing grades, and that which is used up in developing the angular acceleration of rotating parts. The accelerometer, however, when functioning in an automobile being propelled over the highway, confines its determinations to that portion of the power expenditure of an engine necessary to overcome grades and produce linear accelerations. The other four counteracting forces—friction in power transmission, tire losses, windage, and rotational inertia—may be measured by this instrument as a negative acceleration. This is accomplished by permitting the motor propelled vehicle to coast in neutral. Friction wastage in the engine may be taken cognizance of by coasting with the clutch engaged over the transmission in gear. The energy absorbed and yielded by the angular accelerations is primarily reposed in the wheels and this expenditure of power may be calculated from the changes in the machine or wheel speed. The moment of inertia of the wheels can be determined directly by the pendulum method. Such a method of measurement acts upon the assumption that the readings of rolling and frictional resistances under power conditions are identical with those when coasting is resorted to. Exact precision is not thus vouchsafed, but in the interest of simplicity and popular application of the method, it adequately answers for all practical purposes.



Diagrammatic sketch of the accelerometer

"The wind bloweth where it listeth," is a Biblical observation that is necessarily recognized in any experiments that would accurately reflect the conditions under which a motor-propelled vehicle operates. Both the velocity and direction of wind exercise an influence on the motor-car in action. Acceleration measurements, in the interest of accuracy, have to include the speed as well as the course of the wind. The direction of the latter in relation to the movement of the automobile is significant because of the increase or decrease in the effective frontal area. A double-tube Venturi, mounted three or four feet above the top of the automobile, and supported from the running board, measures the relative velocity of the atmospheric current. This unit of the engine-performance testing apparatus is free to revolve about a vertical axis, and is maintained in the wind by vertical vanes in proximity to its exit end. The angle between the direction of the wind and wheel base of the motor-car is conveyed to a recording pen by the angular movement of a flexible shaft.

The speed of the test automobile is determined by an aircraft tachometer, geared to a front wheel. The spindle, which ordinarily is equipped with an indicating hand, is in this case provided with a small pinion linked to a recording pen. This tachometer has no time lag and registers the average speed of the automobile during the preceding two seconds.

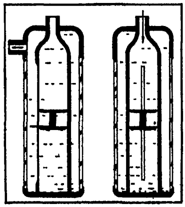
The many-sided, compactly-built, recording unit uses, *for almost* all its work, a single recording drum. Speed of the automobile, acceleration, velocity of the atmospheric current, direction of the wind, manifold pressure, water-outlet temperatures, water-inlet temperature, oil temperature, carbureter-air temperature, transmission lubricant temperature, differential-lubricant temperature, weight of air used by the engine, fuel temperature, and air temperature are all graphed, in inks of varying colors, on a single strip of paper, moving at a non-variable speed of one-tenth of an inch per second. The paper supply is adequate for an uninterrupted service of one hour. The gasoline flow meter camera is a separate unit, a 12-exposure kodak film being used for retaining the impression.

The faithful observations of this humanised recording unit are attuned in harmony with the records of the flow-meter, this delicate adjustment being made by individual timing devices placed on each of these instruments and driven by a single time-contact on the tachometer. The recorded observations are made on unruled paper and the readings are made by use of celluloid template, oriented into position by reference points and lines, and marked with the calibrated pen paths. The supply of paper, record roll, and the driving element, constitute one unit and its removal for reloading is possible without upsetting the testing portions of the apparatus.

Little wonder is it that this test car, with its multitude of ramifications, should have been accorded a weird reception through the rural sections in which preliminary experiments were conducted. With the radio-telephone on the crest of its popularity, the offhand conclusion of the spectators alongside the highway between Washington, D. C., and White Sulphur Springs, West Virginia, was that this automobile was equipped with a wireless outfit. This theory having been summarily exploded, observers were wont to characterise the mechanism as a creation for ferreting out moonshine distilleries.

High-Altitude Mountaineering

IN the *Geographical Journal* for March, 1923, Mr G. I. Finch presents some of his findings on the physiology of high-altitude mountaineering. Mr Finch bases his conclusions on his experience in climbing Mount Everest. Up to 21,000 feet the climber's physical functions were found to be practically unimpaired and good sleep and recuperation from fatigue were possible, but at 23,000 feet sleep was fitful, appetite fell off, and there was a general loss of physical fitness. The conclusion is that at, say, 22,000 feet acclimatization to altitude ceases and above that height oxygen should be used, at first in small doses, and from 26,500 feet in larger doses, but the dose must depend on the nature of the ground. It must also be remembered that oxygen increases the appetite, and due provision *must be made for this.* The stimulating effect of cigarette smoke was noted at 25,500 feet. Although greater heights than these were reached without the use of oxygen, Mr Finch thinks this procedure unwise, and believes that above the acclimatization level a man must become steadily weaker and unable to recover from fatigue unless he makes use of oxygen.



Structure and working of the flow meter

The Trial Trip of the "Leviathan"

A Five-Day Test of the Motive Power, Equipment and Operating Staff

THE trial trip of the "Leviathan" took place over a distance of 2185 miles, on the course shown on the accompanying chart, and lasted from Thursday, June 19, to Sunday, June 24. Starting from Boston Light, the ship passed around Cape Cod and, at Nantucket Lightship, laid her course for Abaco Light. She then passed through the Providence Channel to the Florida coast, and from Jupiter Inlet Light she ran on a northerly course for a 25-hour test at maximum power.

This was the third trial trip of the "Leviathan." The first took place in the North Sea, in the early summer of 1914, when she was fresh from the builder's hands, and, as in the recent test, she carried a large number of invited guests. The next trial was made after her hasty transformation into a transport for American troops during the war. The present lengthy trial was rendered necessary by the extensive overhaul of the main engines, the change of the boiler plant from coal to oil-burning, the complete reconstruction of a large part of the passenger accommodations, the redecoration and refurnishing of the whole ship, the substitution of entirely new lighting, heating and plumbing systems, and the general reconstruction of the ventilating system.

All practical shipping men know that the responsibilities and strain upon the operating staff of a large ocean liner increase more rapidly than the increase in the size of the ship, and they will agree that the decision to give this great vessel, upon whose reconditioning over $8,000,000 had been expended, an extended trial, under conditions similar to those of a regular transatlantic passage, was a wise and necessary precaution. Although the most important trial was that of the motive power, a thorough test was made also, of every part of the equipment and of every department of the personnel. The program of the trial, as handed out to the guests, called for the swinging out of the life-boats by the crew, daily boat musters for the crew with the passengers assembled with life-preservers on; fire drills with operation of the hose and closing of watertight fire doors, tests of the Rich fire-detecting system covering the holds, to say nothing of tests of the powerful Sperry searchlight of 450,000,000 candle-power on the foremast, and of whistles, sirens, telegraphs, ventilating systems—257 in number—salt- and fresh-water sanitary systems, and a score of other elements in the makeup of a giant, high-speed liner—that most complicated of modern constructions.

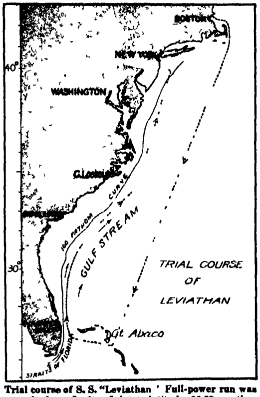
The plan of the trial called for a gradual working up of the power from that represented by 150 revolutions of the propellers at the start, to the final operation of the ship at maximum power for a period of 25 hours. On leaving Boston Light the revolutions were 150 per minute. This was maintained for 12 hours, the technical staff taking engine-room data for the last four hours of the twelve. The revolutions were then gradually increased to 160 and maintained for 12 hours, data being taken during the last four hours. Then for successive periods, the revolutions were increased to 170, 175, 180, and finally to the maximum, with all burners going, if necessary, in all of the 46 boilers. It should be noted that, unlike the Cunard and White Star ships, which use the low pressure White burner, the "Leviathan's" boiler plant is equipped with the Peabody high pressure burner, an American type, which gave excellent results throughout the trial.

There was fog on the first night out, and this caused the ship to fall several hours behind her schedule. She rounded Abaco Light about midnight June 21, passed at high speed through the Providence Channel, and in the early morning swept into the Gulf Stream. Turning north she had Jupiter Inlet Light abeam at 7.17 A. M., June 22, and, with everything wide open reached Diamond Shoal Lightship at 3.39 A. M., June 23, having covered the distance of 570 miles at an average speed of 27.90 knots. Full power was maintained until the "Leviathan" reached latitude 36.52 north, longitude 74.21 west, when it was found that the ship had covered a distance of 687 miles in 25 hours, at an average speed "over the ground" of 27.48 knots—a splendid performance and a world's record for a continuous 25-hour run.

Now it detracts nothing from the merit of this performance to remind our readers that this does not mean that the "Leviathan" is a 27½ to 28-knot ship in still water. To get at her actual speed we must make a deduction for the speed of the Gulf Stream, in the axis of which she was running, and an addition must be made to her speed to compensate for the loss of power due to the high temperature, 85 degrees, of the sea-water which was passing through her condensers.

A study of the current charts of the Hydrographic Bureau of the United States Navy shows that at this period of the year the Gulf Stream runs at a speed of 3¼ to 4 knots off the southerly coast of Florida and diminishes in speed as it spreads out to the northeast. The average speed over the 25-hour course, taking account of the high temperature, was probably about 2.75 knots. Deducting this, we get a speed of about 24.73 knots through the water.

On the other hand, if the speed of the Gulf Stream was a help, its high temperature of 85 degrees was a hindrance to the speed of the "Leviathan." The normal sea temperature is 65 degrees and that rise of 20 degrees played all sorts of mischief with the vacuum—and a high vacuum, be it remembered, is all important in developing the full power of a steam turbine. With sea water at 65 degrees the "Leviathan" would have shown at least 28 inches at the condenser, and this



Trial course of S. S. "Leviathan." Full-power run was made from Jupiter Inlet to latitude 36.52 north

would have meant an addition of 0.75 knots to her speed, raising it to 25.48 knots.

If, at the end of the 25 hours, the "Leviathan" had turned and run back over the course, and the same conditions of no wind and calm sea had obtained, the current effect would have been eliminated, and the actual speed would have been determined with great accuracy. This method is used in all our warship trials over the measured mile at Rockland, the vessel being run alternately with and against the current, the mean speed, as thus obtained, being the actual speed through the water.

As a check upon the above calculations, in which the speed of the Gulf Stream is necessarily no more than an approximation, we have available the closely accurate method of determining the speed of a ship by the revolutions of the propellers. Applying this to the "Leviathan," we find that the pitch of her propellers is 14.93 feet, and that the average revolutions for the 25-hour run were 184 per minute. So, 14.93 (pitch) x 184 (average revolutions per minute) x 60 (minutes per hour) gives us the distance the propellers would move through the water in one hour if the water were rigid. Dividing this by 6080 (one knot) we get the speed in knots per hour. But because of its fluidity the water is driven rearwardly in a variable proportion to the forward motion of the ship. This, subject to certain corrections, is known as the "slip," and experience has shown that, in average weather, with propellers suitable to the ship's form, etc., the slip is about 10 per cent. Making a 10-per-cent reduction, we arrive at an average of 24.39 knots for the 25-hour run.

But the "Leviathan" was using cooling water in her condensers which varied in temperature from 85 degrees at the commencement of the run to 78 degrees at its close, and this had the effect of pulling down the vacuum to as low as 26.5 inches during the first few hours of the trial. Had water been available at 65 degrees it would have been possible to hold the vacuum at 28 inches, as was done in the cool water off Boston at the start, in which case about 0.75 of a knot would have been added to the speed. Thus we arrive at 25.14 knots as the speed of the ship through still water.

From these considerations we are led to the opinion that, in a series of runs, with and against the tide, in deep water, the "Leviathan" when she has been thoroughly shaken down, would be capable of making a speed of 25.25 to 25.50 knots over the measured mile. The "Majestic" (six feet longer and with two more boilers) has averaged 24.70 knots from Ambrose Light to Cherbourg, hence we may look for a spirited ocean contest between these fine ships.

When we bear in mind that the "Leviathan" during the intervening ten years since her launching in 1913, had seen only about eighteen months of service, and that she had spent over eight years lying idle in the water, it will be agreed that the fine results achieved in this trial are a great credit to the Gibbs Brothers, who laid out and supervised, and to the Newport News Company who executed the reconditioning and (in all fairness let us add) to the original builders of this fine ship.

Dynamiting Bedrock Over a Subway Tunnel in New York Harbor

DIRECTLY over a subway tunnel under New York Harbor with only thirty feet of rock between the tunnel and the river bottom above, charges of one hundred pounds of dynamite are daily being exploded without the slightest injury to the tunnel or to the subway trains which pass along its length at frequent intervals. Diamond Reef lies in the bed of the East River, just above the old Brooklyn Bridge, and rises to within thirty feet of the surface at low tide. In order that the largest battleships may pass this point and enter the Brooklyn Navy Yard, as well as to permit the passage of the deep draft vessels now so largely in use in the merchant marine, the channel must be deepened to forty feet. The obstructing reef is of solid rock of a very tough variety, so that before the explosive can work against it to good advantage it must be placed in holes drilled in the rock to a depth of ten feet. This drilling must, of course, be done from a scow on the surface of the water, and it is essential that means be provided for holding the scow rigidly in place when the tides and swells from passing harbor tugs batter it. The scow is equipped with vertical spuds, like a dredge, and these are projected downward until they rest on the bottom. In addition to this, by means of racks and pinions moved by small back-geared steam engines it is possible to raise the scow bodily, not clear out of the water, but some distance above its normal level of flotation. For all practical purposes the scow is now no longer a scow, but a temporary platform on legs and the drilling may proceed with the assurance that the drills will not be thrown out of line above the holes. A battery of three churn drills is mounted on the scow and the holes are sunk to a depth of ten feet on ten foot centers. The scow or drillboat now backs away about seventy five feet, the charges of 80 or 90 per cent gelatin are packed into lengths of common galvanized iron leader pipe and these are lowered into the holes.

When the charges have been connected in series by the wires used for electric detonation, the charges are ready to be fired. Certain precautions must now be taken. On broad principles of safety it is necessary to ascertain that no subway trains are in the section of the subway beneath the river. This is made known by a system of electric signaling that was installed for this purpose. Trains are prevented from entering the tunnel and those that happen to be in it are allowed to pass through. Then the signal is given and the charge is fired. Surprisingly it has been found that so little tremor is felt in the subway only thirty feet beneath the point of the explosions that a glass of water placed on the floor of the tube as a test trembles but slightly

Psychic Adventures at Home

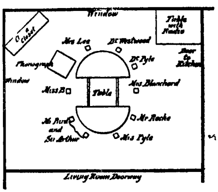
The American Supplement to My European Expedition: A Sitting with Ada Besinnet

By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary of the SCIENTIFIC AMERICAN Psychic Investigation Committee

WHILE he was in New York in April, Sir Arthur Conan Doyle suggested that he might be able to arrange for me, with some of the better American mediums whom I should have difficulty in approaching directly, a few informal seances of the same sort as my English ones. He was encouraged to do this and presently I had a wire instructing me to meet him in Toledo on Thursday April 26 for a sitting with Miss Ada M Besinnet. Miss B, as I shall call her for economy's sake, is regarded by spiritualists as one of the world's foremost mediums.

The seance was held in the dining room of Dr John S Pyle's residence, at 1064 Prospect Street. Dr Pyle is one of Toledo's leading medical practitioners. He has known Miss B from the age of twelve and has watched her mediumship develop from its earliest stages with an interest which seems to be in equal parts friendly, professional and scientific. Of the other members of the group whose names appear on the diagram special mention must be made of the Rev Horace Westwood, pastor of the First Unitarian Church of Toledo, who has for some time been interested in Miss B's mediumship and who was one of those who defended her against Mr Black at this time last year. Mr W W Roche of the Toledo *News Bee*, is known to our readers in this same way. Save for myself in fact, all the sitters were close friends of the medium and fairly frequent sitters with her, so from the spiritualist viewpoint a brilliantly successful seance could be anticipated.



The two chairs bracketed under the names of Sir Arthur Conan Doyle and Mr Bird were occupied in alternation by these two sitters who on three occasions during the seance were instructed by the controls to exchange seats. Miss B was the medium

Arrangement of the sitters and the furniture at the seance described in the accompanying article

The party assembled early, Miss B likes a bit of social contact beforehand, to get an atmosphere. The Pyles live in a thoroughly typical detached cottage of the sort found in the outlying residence districts of American cities—"villa" is the word for my European readers. Considerable preparation was involved, in which all hands joined. I watched carefully for evidence that certain tasks were done by certain people, that furniture was placed in particular spots etc, and found nothing whatever of this sort of suspicious doings.

Miss B requires total darkness. The two windows were sealed by means of dark curtains fitted close to the glass outside the conventional dark shades. The living room, wide open to the street through a door and numerous windows, could not well be darkened. It joined the dining room through a wide open doorway. The big rug that carpeted the dining room was taken up and hung in this opening. Along one side of the rug was a series of loops, with nails to match along the wall above the frame of the doorway. The rug was adjusted with complete success, cutting off all light from the front of the house. I was informed that while seances had been held at the Pyle house before, they are by no means so frequent as this preparedness might lead one to suppose.

The dining room contained an extension table, a smaller table in one corner with a vacuum tube radio outfit on it, a large china closet, and a cabinet phonograph. Of these articles, only the phonograph was moved from its permanent place. The dining room chairs were supplemented from other rooms.

Miss B's controls demand a "solid" table. The extension table, whether the leaves be left in or taken out, has one or more joints which violate this requirement. So it is opened as though several leaves were to be inserted, and the operators accept this as the equivalent of two separate "solid" tables. The medium then sits, not really at the table at all, but at the opening in the table. Obviously this would give her better access to all parts of the table and circle than she would have with a more conventional arrangement. The extent to which she could circulate in and out of the well in the center of the table is, of course, entirely problematical. The "runners" along which the table slides and which hold the two ends together would hinder this in some ways, and I suspect in others they would facilitate it.

Miss B has phonograph music throughout her sittings, and since her controls insist upon their familiar and favorite airs, she carries her own records with her—she even carried them to England. Their unpacking was delegated to me. From a large suitcase I removed some fifty large and small records of the disk type, two tambourines, a sectional trumpet of cheap leather or heavy cardboard, a writing tablet, a pencil, and about ten yards of rope in two pieces. All this was piled indiscriminately upon the table, then Miss B sorted the records out into three groups—vocal, and loud and soft instrumental.

The phonograph was at the medium's left, where there was barely room for it between table and china closet. It seemed an effective barrier against her moving about in that direction. The privilege of tending it during the seance was offered me, and declined on the ground that it would take too much of my attention. On the whole this was a wise decision, but there were moments when I wished I were at the machine, and in a series of sittings I should take this position at least once. The duty was finally assigned to Mrs. Lee; the rest of the company sat as diagrammed. There was no physical obstacle against the medium's moving about to her right, but Sir Arthur and I observed no evidence that she was ever doing so.

Miss B's controls are two in number: Pansy, a little girl, and Black Cloud, the inevitable Indian. Pansy speaks in a lisping childish tone, Black Cloud throws in two or three words at a time in staccato grunts. Both are apt to rap instead of speaking, if what they have to say is covered by the code. Like a good Indian, Black Cloud is hard to amuse, but he finds white squaws more to be laughed at than the generality of things, and he laughs at them by gently shaking the table.

Hands were placed, flat and unjoined, on the table and we were insured that the controls would rearrange them whenever they wanted them rearranged. The white lights were replaced by a single red bulb, this was extinguished, and the seance was on. At intervals, one of the sitters would ask, "Are you here, Ada?" After perhaps five minutes the question failed to elicit an answer, so someone asked "Are you here, Black Cloud?" The answer was "Yes," in very faint raps.

Before the medium was thus marked as having gone under, lights appeared, quite bright and of considerable range and speed of travel. I was told that this was usual. After the controls had taken charge, the lights continued for some time to be the only phenomena, but presently we began to get vocal effects. These were confined to singing and whistling. A tune or a song might be played through on the machine without incident, but always there was the prospect that the whistler would join the tune, or any one of numerous singers would add their efforts to the song.

MORE than once we have pointed out, in a place like the present one, the distinction between Mr. Bird's personal and informal examination of mediums, and the formal tests carried out by his committee. Heretofore, there has been a geographic basis for the distinction, in that the informal work had all been done in Europe and the formal sittings held all in America. With the present instance, this geographic barrier is broken down, we have Mr. Bird holding an informal seance with an American medium, in America. It therefore becomes doubly important to insist, as he has done, upon the fact that this sitting was not given in the presence of our committee and has no standing with them. Miss Besinnet has not even expressed a willingness to sit with them, in fact, so the reservation must be made on her behalf as well as on ours.—THE EDITOR.

These voices were altogether extraordinary. They came clearly from the well in the center of the table. On one occasion the large end of the trumpet was presented for me to put my ear to, verifying that the voice was not in it, and most certainly it was not. Without exception the voices had the touch of personal characteristics, thus, one female voice had a distinct Irish lilt. There was a prodigious rich tenor, sufficient in volume to fill a cathedral. This particular singer has a name—he is Dan, and he attends all Miss B's sittings. Collectively the voices ran the gamut of the piano range, from the tinkliest treble to the deepest and most goose-fleshy bass. Even if one were prepared to believe that Miss B could produce Dan's colossal voice, one would stumble over the assumption that one person could have such a range. And I have never heard a tune carried so well by any other whistler as tunes were carried by the whistle that came from the center of the table.

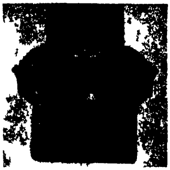
Mrs. Lee had the phonograph records piled before her, and it was her duty to keep the machine wound and supplied with records. On the second or third record attempted, the music was cut off immediately it started. Mrs Lee denied having done this, Black Cloud explained, in answer to questions, that he wanted a softer record. Throughout the seance when a record was stopped, the motor wound, the lid raised or lowered to alter the volume, or a record put on or taken off, Mrs. Lee would state whether she had done it or not. Usually when she entered a disclaimer, Dr. Westwood was able to assert that he was in contact with both her hands. Quite usual was stoppage of the machine and rejection of a record that had been put on without consulting the controls to see which sort of record they wanted. Once we had something fairly evidential, the motor was wound "independently" when the medium was clearly marked by contact with me as being in her seat. The handle was on the side away from her, and it seemed unlikely that she could reach it, or having distorted her arm to reach it, turn it.

Toward the end of the seance we got trumpet voices on a small scale. The trumpet would be presented directly to a sitter, and the message given in a whisper that was quite inaudible to the others, and almost so to the one addressed. There was also a performance with the tambourines. One of these had a spot of luminous paint, by virtue of which one could follow it as it travelled about above the table, in and out over the heads of the sitters. While thus travelling it played an accompaniment to the phonograph tune; one of the ladies remarked that she had not realised that such good music could come from a tambourine, and I was inclined to agree. The tambourine and the lights in their travels covered space above the center of the table, to which it was difficult to see how the medium could take them by hand without getting tangled up in the lamps and arms of the chandelier.

While this medium does not sit tied as does Powell, the ropes play a part in her performance. The control announces that the medium is to be tied, and after an interval of five or ten minutes requests that the red light be turned on and the work examined. The medium is found in apparent trance, with her hands

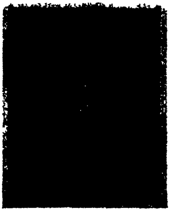
(Continued on page 211)

Introduced in 1896 A Columbia typewriter of dial form with 72 characters on the edge of a vert cal disk or wheel



Invented n 1850 b S A H ghes A typewriter f the bl nd

Designed in 1851 by Sir C Whea st ne f r the rapid printing of telegrams A typ writer w th a p an -l ke keyboard



Now in the National Museum at Washington The Burt Typographer of 1829

An early Pratt typewriter of 1865 p e-ced g the Pratt typewriter of 1866

Patented 1873 The Remington (or ginally known as he Scholes-Glidden)

Made and atented by John P att in 1866 w th 36 symbols o a ve t ca r le

Patented in 1880 The Bar-Lock typewriter No 1 model, resembling certain types of present-day machines

Once the property of Sir Henry Irv ng A Hammond typewriter patented in 1880 The ty e on a segment bar

Patented in 1881 by Thomas Hall of New Yo k The Hall typewriter w th s uare rubb r sh et as fou t

Patented in 1884 by A H Guhl The "Hammonia typewriter with 45 characters on the edge of a thin straight blade

Made in 1890 A machine lent f exhibition by the E glish Typewriter Company with 29 type-bars arranged in an arc

Patented by J Gardner in 1893 A mach n eant to reduce s se

THE typewriter in practical form, is fifty years ol l Th earliest reference to a writing machine is the recorded invention of an Englishman named Mills, who is said to have patented a typewriter as long ago as 1714 The first salable machine, however was the work of two Americans named Scholes and Glidden who after some thirty attempts had a typewriter placed u the market by a firm of gunmakers in 1873 This was the found tion of the typewriter industry Another Am ri an nam d Soulé devised the pivotal type set in a circl The shift key for using a capital as well as small lett r o e h typ bar w s i ented in 1878, a l other i pr n t f ll w l until the typewriter as we k w it t d y w s c ol l We are indebt d to the *Illustr ted L o Ne s* for the accompanying excellent ill str t s

SOME MILESTONES IN THE DEVELOPMENT OF THE MODERN TYPEWRITER

Keeping the Ash in Motion

Continuous Mechanical Discharge of the Unburned Residue, and Its Role in Boiler Efficiency

By David C. Spencer

ONE of the problems which constantly confront boiler room engineers and operators, is the matter of cleaning fires and discharging the ash. To the average layman, this may seem like a simple proposition. In the case of small furnaces where operation is carried on at nominal rating or less, possibly the situation is not so difficult. But in these days of large units and continuous operation at high overratings, the problem assumes an entirely new aspect.

Boiler operation may be classified in two groups. There is the station or plant whose load changes frequently, sometimes slightly, at other times in violent swings. The boilers may be delivering steam at 100 per cent of rating at one minute, and five or six minutes later be required to deliver 200 or 300 per cent of rating, with an equally sudden drop when the load goes off. Such experiences are not infrequent in central-station practice or in such industries as pulp and paper mills, rolling mills, power stations of coal mines, etc.

Then there is the station whose load is fairly constant for an extended period of time. Such changes as occur are gradual and can usually be anticipated. There are practically no sudden fluctuations. Instances of this class are found in the case of power companies operating two or more stations, one of which carries the swing, while the others operate at a uniform rate. Among industrial plants a good example would be a shop equipped with machine tools or a spinning or weaving mill where production is fairly steady.

In stations of the first classification, the operator's problem is to deliver steam when and in the quantity, that is required by the plant processes. In the case of central stations supplying light to the community and power to the traction lines, a sudden storm for example, means an instant increase in both the lighting and power load. This increase must be met and carried by the boilers. In the industrial field the sudden call for steam for process purposes, as for example vulcanizing in the rubber industry, means an equally sudden peak which the boilers must take. The operator's problem in such cases is, as has already been stated, to deliver the steam. To accomplish that he must have an equipment that is highly flexible.

The elements which make for flexibility are the reserve capacity of the stoker and the ability to clean the fire quickly, easily and thoroughly and that the cleaning period should be variable at the will of the operator. The reserve capacity of the underfeed stoker is so well known as to call for little additional comment in this discussion. Suffice it to say that the multiple-retort stoker with its deep fuel bed provides in the greatest degree the first essential element.

The power dump is without exception the most satisfactory method of cleaning fires where conditions exist such as have been outlined. It gives the operator absolute control over his fire. He can, if necessary, increase the rate of coal feed to meet almost any contingency that may arise. Every operator knows that the question of capacity is largely one of the amount of grate area that can be installed under the boiler. Temporary operation of 500 or 600 per cent of rating is not beyond the point of possibility, provided the boiler can be stoked up to that point. But it would probably be uneconomical from a good many points of view because so seldom required.

The same output, however, can be temporarily attained with a much smaller stoker if the operator feeds the coal in at a high rate, burning off the volatile and discharging a large proportion of the coke. Naturally this would be very wasteful operation, but when the operator is confronted with the necessity of delivering a certain amount of steam or facing a shutdown, probably it would be the less wasteful course to pursue. Of course, this is an extreme case. A capable operator seldom gets caught in a jam which would require operation of that character. But he frequently finds himself under the necessity of increasing his steam delivery 50 to 100 per cent or more without warning. Under such circumstances he must put more coal through the stoker even though by doing so, he may lose a considerable amount of unburned carbon.

As has been said, the power dump is probably the most effective method of cleaning fires to accomplish this purpose. It provides a variable rate of ash discharge that functions at the will of the operator. It requires the minimum amount of time to drop the dump plate, so that the accumulation thereon may fall into the ash pit, and return the plate to its normal running position. A glance at the accompanying drawing will show why it is easily possible to perform this operation in less than half a minute. It is especially noteworthy that in such operation with the power dump, there is practically no interruption to steaming as the result of the dumping period.

Stoker in a Philadelphia power plant fitted with two-roll rotary ash discharger

Cross section of mechanical stoker equipped with power dump for ashes. The arrows show the direction of air circulation

In the second class of operation the problem is entirely different. With a fairly constant load, the operator seeks, naturally, to operate his plant at the point of maximum efficiency. There is comparatively little need for the ability to clean fires instantly. Rather, there is urgent need for as nearly as possible clean fires at all times. The ideal way to maintain clean fires is to discharge the ash as rapidly as it forms—in other words, by means of continuous ash discharge at a rate proportional to the rate of combustion.

The most practical and satisfactory device for accomplishing this result is the rotary ash discharge which has been brought to a high state of perfection. One of its essential features is a deep ash pocket. This pocket must not be regarded as primarily a storage place for ash. If that were the only requirement, an ash pit would probably answer the purpose.

It is extremely difficult to handle hot ash. After the ash has become cool, it can readily be broken up and discharged. The ash pocket serves as a space in which ash may be treated or conditioned for discharging. The conditioning of the ash involves the final burning out of any combustible which it may contain after it leaves the stoker proper, and the cooling of the refuse.

To provide for this the ash pocket is divided horizontally into two sections. The upper section is flanked by a grate somewhat similar to the extension grate of the stoker itself. This is provided with ports through which air may be admitted in any desired quantity. The combustible which remains in the ash after it reaches the pocket continues to burn while in this section and this results in reducing to a minimum the combustible in the final residue and, therefore, in increased combustion efficiency.

The lower portion of the pocket is flanked by cast iron crusher plates. These provide a surface against which the clinker can be crushed. In all double-set arrangements of the stoker there are crusher plates on each side of the pocket. This is also true of single set arrangements where two crusher rolls are provided. When only one crusher roll is used, the crusher plate is on the stoker side of the pocket and the bridge wall side is lined with a rigid cast-iron plate.

The crusher plate is movable so that the gap between the plate and the roll may be adjusted to any desired width. This provides for crushing the clinker to any size suitable for easy handling by any ash disposal system. It also permits a certain degree of variation in the rate of ash discharge although this is a secondary function. Finally, it provides a means whereby the ash pocket may be emptied when the stoker is off the line for cleaning or overhauling.

The crusher rolls are the operating element of this system of ash discharge. They consist of cast-iron shells mounted on a steel shaft which has a square cross section. The shells are built up in sections for convenience and are armed with teeth that have a triangular cross section. These teeth are made of special cast iron which is very durable and are made removable for ready replacement. The design of the teeth is such as to provide the maximum crushing force with the least strain on the rolls or mechanism.

The rolls may be operated by the stoker drive or independently as desired. In either case provision is made for varying the speed of the rolls independently of the stoker to regulate the ash discharge rate.

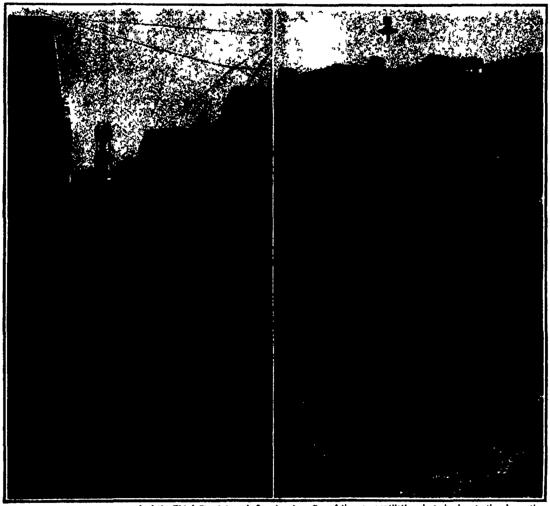
Ventilating an Existing Tunnel

SO great has been the increase in motor vehicle traffic in American cities that those which have street tunnels are finding in many instances that a new and serious problem has been created. The exhaust fumes from motor cars are not infrequently the occasion of much annoyance in busy city streets and even cause serious discomfort when wind and weather conditions are such as to cause the fumes to accumulate. But far more serious is the accumulation of motor fumes in traffic tunnels. These bores were originally constructed when automobiles were few or wholly unknown. With the advent of the gasoline engine and the resulting increase in the number of vehicles on the streets many tunnels have become traps for fumes which in some cases have actually endangered the lives of persons passing through these bores.

So serious has the problem become in Los Angeles that it has been necessary to sink two perpendicular ventilating shafts from the top of the hill through which the city's most used tunnel passes, so that by means of electric fans the foul air in the underground passageway can be drawn off. By this means the air is changed entirely every few minutes. One of these shafts is 42 inches in diameter and the other one approximately 18 inches.

The problem of how to dig or drill these ventilating shafts proved an unusual one when the city engineers started out to find a concern that would undertake the contract. The task was different from the ordinary run of drilling or digging jobs and the authorities were somewhat at loss to find men competent to undertake the work. The most practical way seemed to be to drill the hole from the top of the hill to the roof of the tunnel with some kind of well-drilling apparatus, making the bore as large as possible. Accordingly a driller of oil wells was hired who drilled the smaller of the two holes already mentioned at what was conceded a reasonable figure. Before he had finished his task, however, the work attracted the attention of a man who owned and operated a manhole digging machine. His equipment was entirely different in character and by means of a rotary digger he was able to sink a 42-inch shaft at no greater labor than that with which the driller could sink an 18-inch shaft. Accordingly, the contract for the second vent was transferred to the manhole digger, who has completed his half of the task at a figure a little lower than that charged by the well driller. Under all the circumstances and in view of the unusual character of the undertaking the city felt that both men had earned their money.

The improvement in the way of two vents with electrically operated fans has proven highly satisfactory and the much used Third Street tunnel, which is nearly a fifth of a mile in length, is now filled at all times with clean, wholesome air. Formerly when there was little wind and traffic was heavy the bore contained such dense fumes that pedestrians found it almost impossible to make their way from end to end.



Left Street view showing east end of the Third Street tunnel, Los Angeles. One of the new ventilating ducts is close to the observation tower. *Right* Sinking the 42-inch ventilating shaft, 90 feet deep, with the use of a manhole digger

Los Angeles' street tunnel, designed in motorless days, has had to have ventilating shafts added to take care of the exhaust gases from automotive traffic

The Use of Paper in Gardening

WHILE the use of paper for many useful purposes in gardening, raising flowers and vegetables, may not be new, nevertheless the advantages, which may be gained by such practice, are not generally known. Most people know that paper is a good heat insulator, that is, it is a very poor conductor of heat. Hence, when an object is enveloped in paper its inherent heat is prevented from being rapidly dissipated and at the same time the cold or hot air, surrounding the object, is prevented from coming in contact with it and either detracting from or enhancing the heat contained in the body.

It is this property of paper that makes it so useful in gardening. Furthermore, while ordinary paper is non-transparent and non-translucent when the paper is oiled, it will allow light to pass through it, and at the same time it will be effectively waterproofed. This fact is also of importance in rendering paper applicable for many purposes about the garden and the greenhouse.

Actual practical experience has shown that it is possible to obtain effective protection for young seedlings and tender plants against the inclement weather of winter and early spring by the use of paper. Instead of employing expensive glass for the windows of frames and greenhouses, oiled paper may be used with just as good results and in fact, if taken care of as conscientiously as glass, they will last just as long. Of course, the cost is very much less. It must be mentioned that such oiled paper lights may be exposed to the weather as much as possible and still possess long life. Another saving is in the construction of the frames, which need not be nearly as heavy as when glass is used.

The use of paper for this purpose is not in any way universal, but it is due simply to ignorance of the effectiveness and the cheapness of the material. In France, where intensive cultivation of vegetables is carried out to a far greater degree than in this country, the value of paper for making the windows in hot house frames has been appreciated for some time past and paper is largely used for this purpose in that country. Very good results have been obtained in the use of oiled paper for covering pits in which there were stored surplus chrysanthemums, tender shoots and similar plants that must be protected in green houses during the cold winter months. When the seedlings first send up their shoots above the ground, it is often necessary to shade them from direct sunlight. In this connection it has been found that the diffused light which penetrates through oiled paper is particularly well suited to them, and the shades, which must be erected when glass frames are used, are unnecessary in this case.

Old newspapers have been put to many purposes. They sometimes serve to protect the person against cold in lieu of an overcoat. The same property, which renders them useful for this utilitarian purpose, makes them a very effective protection against cold for tender plants. In the early spring, when frost may still appear on the ground over night, it is a wise gardener who covers up his plants with newspapers as the evening sets in and does not remove them again until all the frost has disappeared the next morning. If this is done regularly and conscientiously, no fire heat at all is required, thus simplifying matters and saving money.

It may be mentioned that when newspapers are used as protection against frost, it sometimes happens that one forgets to use them a certain day and the next morning the plants are frozen. Heroic means must then be taken to bring them to life again. The best thing to do is to spray them with ice cold water before the sun is up and to protect them against the sun's rays with paper covering for some time thereafter. The remedy is drastic but sound.

An instance is cited of a large hot house full of cinerarias, which were completely frozen over a certain frosty night due to the heating apparatus going out of order. The plants were quite black and apparently ruined, but were brought back again without any ill effects by means of the above treatment.

"Only a Little Trickle—Let It Run"

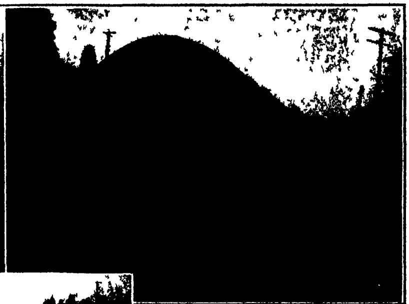
THOSE best qualified to express an interest in waste of water are those who have the bills to pay. It is in communities where water is not metered that waste is most apt to be ignored, but in the long run the waster pays the bill. To enable the average person to visualize the amount of waste that can result from leaving tiny streams running, a Mattoon, Ill., maker of water works equipment has issued a pocket piece resembling a twenty dollar gold piece. This will assure its attention at the start. Of three tiny holes which are bored through it, the largest is only one-eighth of an inch in diameter, yet the pocket-piece bears the legend that in a day of 24 hours, 3600 gallons of water would be wasted from an opening of this size. Another hole which will not permit the insertion of a pencil lead is stated to be the potential waster of 900 gallons per day, while a third hole just large enough to receive a pin is nevertheless large enough to permit the flow of 180 gallons or over $3\frac{1}{2}$ barrels. This corresponds to about 140 cubic feet per week.

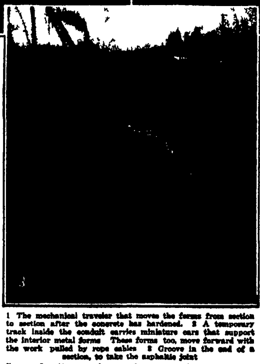
The figures given are for a head of 40 pounds. Higher pressures would increase the waste, though not in direct proportion to their values. The next time you see a tiny leak, remember that it is capable of making a larger dent in the purse than appearances would indicate, and do not be surprised if a rigid inspection of plumbing is carried out at times when a water famine is a possibility.

More Water for Washington

The Great New Conduit that Will Double the Capital City's Supply

By George H Dacy





1 The mechanical traveler that moves the forms from section to section after the concrete has hardened. 2 A temporary track inside the conduit carries miniature cars that support the interior metal forms These forms too, move forward with the work pulled by rope cables 3 Groove in the end of a section, to take the asphaltic joint

Some details of the work on Washington's new water-supply conduit

IN ORDER that Washingtonians may have plenty of water to drink—the City of Presidents has been menaced by a portending water famine for several years—Uncle Sam is building a large new water conduit that extends from Great Falls Md to the boundary of the District of Columbia where a new model filter plant will be installed Away back in 18 6 the first conduit a circular brick tube nine feet in diameter and nine miles long was constructed to carry the water supply of our National Capital from Great Falls to the Washington consumers This sanitary water channel or tunnel was one of the great engineering feats of that day and age Subsequently, a permanent government road was built directly above the mammoth pipe line Entrances to the conduit were provided at intervals of approximately 1000 feet

All went well and the city of Washington was blessed with a superior and abundant water supply until about a decade ago when our most beautiful American city began to grow and attain the dimensions of a world wide capital The population increased very markedly With the advent of thousands of more thirsty consumers the water supply began to be inadequate Now with a population of more than 438 000 permanent residents with untold thousands of transients thronging into the Federal capital daily the 24 hour water supply of 100 000 000 gallons is insufficient And peculiarly enough the consumers use more water during the winter than during the droughty hot and muggy months of summer probably due to the fact that many let their water run constantly to keep the pipes from freezing Conditions are such in our Capital City that sanitary drinking water has to be used in washing the streets sprinkling lawns and extinguishing fires

A new concrete conduit is now under construction which parallels the route of the old conduit No more convincing evidence of the revolutions that have been worked in engineering and construction operations is to be had than to contrast the systems of building employed in installing the old conduit and its new supplement Admittedly the work of more than a half century ago was excellent It has withstood the onslaughts of time and well served its purpose A product of an era of cheap hand labor the old conduit has been efficient and durable Modern engineering however is doing now in weeks what it took many months and even years to consummate during the period prior to the War of Secession

The concrete pipeline now under construction is 10 feet high and 10 feet wide being of horseshoe form Whereas the conduit now in use has a cross section of about 60 square feet its concrete counterpart is approximately one-quarter larger When completed the twin pipelines will have a combined carrying capacity that will practically double the existent Washington water supply There will be the additional beneficial feature that potentially if either of the conduits need repair such a one can be temporarily put out of commission without putting the District of Columbia on short rations.

The concrete conduit is being laid in 80-foot sections, the facilities being such that one of these sections of concrete can be prepared daily Extraordinary metal forms are used which take the doubt and danger out of concrete work and which immeasurably expedite the work The excavation is accomplished by the use of powerful steam shovels—mechanical diggers that have eliminated the arduous hand toil from trench work After the trench is properly prepared the concrete base of the conduit is laid in place—this foundation is 10 inches thick the wall of the conduit pipe being smallest at the base point The walls are 84 inches thick at their base point and 12 inches thick at crown of the arch In the neighborhood of 100,000 cubic yards of concrete will be used in the building of the nine-mile conduit the mixture being a one, two, four combination

Two lines of temporary steel trackways are installed when this concrete foundation is set thoroughly The inner tracks provide transportation facilities for a series of small cars that are equipped with turnbuckles and powerful jacks that govern the raising and extending or lowering and collapsing of the interior metal forms that hold the concrete in place. Briefly these metallic forms, which strikingly simplify concrete construction of this character, can be moved about on the midget cars that run on the inner trackway When the time comes to move the interior forms they are lowered by means of the jacks and loosened by use of the turnbuckles Cables are adjusted properly and hitched to a gasoline tractor that runs along the roadway above the trench, and acts as a steel horse to haul the steel forms to the next position of setup

The other pair of steel tracks extends along either side of the conduit and provides passageway for the exterior forms which are hung on a special traveler that will convey them to the next point of construction Turnbuckles and hoisting devices are used to raise and widen the exterior metal forms after the concrete has been poured and set sufficiently for such operations Altogether, the national engineers are using three sets of these mammoth metal forms which cover a stretch of 240 feet They pour the concrete in the last form of the train first so that by the time they are placing the concrete in the third form the first one can be moved to a position 240 feet farther down the trench This arrangement eliminates any cessation in the work in order to wait for the concrete to set. The exterior forms are moved to new positions in the same way as the interior ones by hitching them to the tractor and hauling them to the new section of construction After the concrete of the conduit has hardened sufficiently a steam shovel is used to fill in around the huge underground waterway The trench is partly filled with water as the earth is dumped into place so that it puddles and compacts as desired without any additional man labor

In excess of 465 000 cubic yards of earth will have to be excavated before the concrete conduit is completed about June 30, 1924 The cost of the subterranean tube will be more than $2 058,000 In the rocky region fringing the Chesapeake and Ohio Canal and the Potomac River great difficulty has been experienced in cutting the ditch for the pipeline Over one stretch of two miles, the cut has been made through solid rock and has ranged from 10 to 60 feet in depth At Cabin John, Md, where is located what was formally the largest masonry arch in the world but which is now surpassed by one built latterly in Germany, a huge concrete-and-steel siphon will be installed to carry the water through a gap that is 550 feet wide and 104 feet deep The siphon will consist of a circular steel pipe ten feet in diameter, which will carry an interior coating of concrete six inches thick, as well as an outside overcoat of the same material that will be 12 inches thick Two tunnels will also be cut at as many hilly sections of the route that will aggregate 800 feet in length, for inspection and possible repairs.

Protecting a Beach From Erosion by Ice

THE extent to which lost motion and labor can be saved by planning is shown by a piece of construction which the writer did with his own hands unaided in ten days' time. The job consisted in the construction of a concrete sea wall to protect the beach in front of his home in Northern Michigan from the ravages of the yearly spring ice flow.

The wall was of trapezoidal section, 8 feet 6 inches thick at the bottom, 12 inches thick at the top and 8 feet 6 inches high. The lower 18 inches of height was under water. The essential points wherein labor was saved lay in:

1 The use of a single section of non-collapsible form, which was set and filled one day, and moved ahead and filled again the following day This form was weighted in place by two rocks not being nailed, so that no wrecking and rebuilding was necessary The rocks were simply removed the form lifted slightly to loosen it and pulled ahead by hand into its new position

2. No gravel was mixed with the mortar Dry stones graded in size from that of a hen's egg to that of a man's head were placed in the form A very liquid mortar of sand, cement, and sufficient lime to insure fluidity, was then mixed with a hoe in a mortar box and dumped into the stones, where it flowed down filled all the interstices and bound the whole together into a solid mass. Thus about 90 per cent of mixing labor was saved, beside making it possible to substitute the relatively easy hoe mixing for shovel mixing

3. Sand dug out of the trench for the wall was thrown directly into the mortar box, ready for mixing, without any further handling

4 The mortar box was supported directly over the wall, so that by simply removing a movable end, the mortar ran by gravity into the forms.

The wall was poured in sections and only half of the height poured at one time, the upper half of one section being poured at the same time with the lower half of the following section Thus 7 feet 6 inches of wall was completed each working day

In the morning a row of light sheet piling was driven in front of a section of wall to keep the waves from dashing into the work The sand was then excavated to a depth of about 18 inches below water line, and a layer of old plank laid on the bottom and weighted down with rocks The form for the lower part of the wall was then moved ahead placed on the plank floor and weighted into place The form for the upper section of wall was moved ahead on to the lower section poured the preceding day

In the afternoon, both forms were filled with rocks placed by hand, and the grout sufficient to fill the voids between the rocks was mixed and poured Usually two batches would do this There was usually a little time remaining in the afternoon, which was given to finishing the surface and painting with a waterproof cement paint

The wall was also tied together longitudinally by several second hand light weight railroad rails which were purchased from the owners of an abandoned mill nearby, and which were placed by hand in the forms before locating the rocks around them Four of these were bedded in the wall for its full length The space behind the wall was afterward filled solid with sand and boulders hauled in by a local farmer

The prevailing wind is diagonally toward the beach and there is a continual drift of sand along the beach by reason of this diagonal motion of the waves After building the wall the writer conceived the idea of placing obstructions in the way of this sand drift to hold it and build a beach outside the wall making things additionally secure He drove a few lines of sheet piling just outside the wall and transverse to it, projecting a few inches above water The result was that in a couple of weeks a strip of beach from six to eight feet wide was made outside the wall The first season's use has shown this to be a thoroughly satisfactory protection the sloping front face of the wall deflecting the ice upward and breaking it up as it floats inshore

The owner of this bungalow has temporarily checkmated the spring flow of ice in the lake, which threatened to scour his property off the map

This blast was produced with charcoal, impregnated with liquid oxygen

Liquid Oxygen as an Explosive

LIQUID oxygen is produced commercially by the fractional distillation of liquid air The latter substance just like the ordinary atmospheric air, contains 21 per cent of oxygen and 79 per cent of nitrogen The nitrogen is more volatile, and evaporates more rapidly than the oxygen Taking advantage of this, apparatus has been designed for evaporating all the nitrogen out and leaving the liquid oxygen This is cheaper than condensing free oxygen because it avoids the expense of getting the free oxygen in the gaseous state free from impurity

Among the interesting possible applications of liquid oxygen one is as an explosive in connection with charcoal Wood charcoal at zero Centigrade will absorb 18 times its volume of gaseous oxygen, at the temperature of liquid oxygen it will take up 230 volumes instead of this mere 18 The charcoal thus impregnated burns with such extreme speed as to give violent detonation

The explosion pictured was produced by liquid-oxygen impregnated charcoal, using home made methods exclusively The charcoal was finely powdered and placed in a linen sack 3½ inches in diameter and 15 inches long to the end of which was fastened a dynamite fuse without any percussion cap A hole was prepared under a 14-inch stump and after submerging the sack of charcoal in liquid oxygen for about two minutes it was placed hastily in the hole tamped and the fuse lighted The explosion was similar to that of dynamite The stump was entirely removed and the roots so shattered that it would require very little additional work to remove them while it seems that after using dynamite the stumps are often merely split without removing them

It is suggested that liquid oxygen can be made at a price to compete with other commercial explosives. Other substances such as cork, salt sawdust, etc may be used in place of charcoal

Laying Rails 420 Feet Long

WHILE engaged in relaying track the street railway line in Washington, D C, recently adopted an unusual method of welding and installing its rails without interruption to traffic. The rails to be installed were laid along the side of the street parallel to the track, welded together during the day time by means of thermit welding into continuous lengths of several rails, then transported with the aid of a large gang of men equipped with rail tongs close to the edge of the track and installed during the early inactive hours of the morning In one case a pair of rail lengths each consisted of seven rails, making continuous lengths of 420 feet as shown in an illustration

Welding rails before laying, and placing them in 420-foot lengths after traffic has ceased for the day

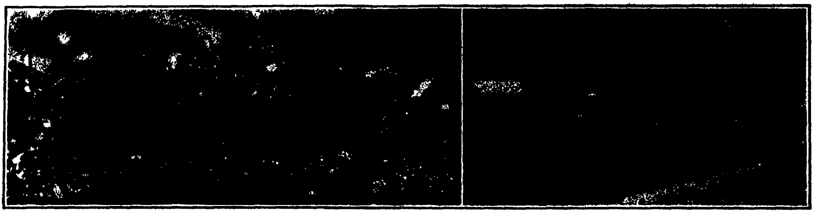
Aluminum Scenery

WOOD has become very expensive in Germany so that at the Chemnitz Opera House aluminum has been substituted for wood for the frames for scenery Scenery thus mounted is much easier to handle and the fire risk is minimized The scenery can be attached to both sides, and even decorations can be painted on the wooden frames No acoustic difficulties have been experienced

Weathering Tests of Stone

WEATHERING tests consisting of freezing and thawing of the specimens until disintegration occurs are in progress at the Bureau of Standards on 22 samples of limestone and 23 of sandstone Some of the best limestones have withstood 800 freezings without showing any appreciable amount of decay while the poorer grades of this material were disintegrated by 100 freezings Tests on the sandstones have only recently been started and so far the samples have shown no great amount of decay

A number of limestone and sandstone specimens are also being tested by soaking in a 15 per cent solution of sodium chloride and drying afterwards to obtain a crystallization of the salt in the pores of the stone This produces an action similar to that of frost but more severe It has been found that limestones which stood up under several hundred of the freezings were disintegrated by less than 100 crystallizations in the salt test However the actual disintegration seems to be similar to that produced by the action of frost and hence it is believed that there is a possibility of using this method as an accelerated weathering test



Left Army ants marching in single file note the great killing mandibles on the central figure (magnified five times) *Right* Army ant bringing home as booty the leg of an insect victim. This straddling of the burden is characteristic

Scenes from the Guiana jungle, when the ants are marching

The Army Ants of British Guiana

Jungle Insects that Have Learned the Importance of Force of Numbers and Discipline

By Paul Griswold Howes

Assistant Curator of the Bruce Memorial Museum, Greenwich, Conn.

UPON the ever moist floor of the great dim jungle that covers nearly all of British Guiana, live the gypsy tribes of army ants. These tribes consist of astounding numbers of individuals, divided into various sizes, and upon whom fall various burdens in the general economy of the groups. They make no permanent nests at all, but instead roam the forests, carrying the entire where-with-all of their social existence about with them

The first army that the author ever witnessed on the move, was traveling rapidly across an open space in front of the camp. The line of march was not over five inches in width, but it extended across the clearing for a hundred and fifty feet in a snaky band, and continued out of sight into the growth of vegetation beyond. This army moved for many hours without halt, or even the slightest let up, and there must have been hundreds and hundreds of thousands of individuals in the line Their destination was an old foundation on the edge of the clearing, and into this the insects poured all day long. The ants carried everything that belonged to them as they moved Nurses could be seen by hundreds, bearing the white grub-like larvæ or young ants, while countless others carried eggs and pupæ, or ants about ready to take up their work in the tribe Soldiers with enormous curved jaws hurried along with the rest, snapping viciously at anything that attempted to interfere with the general progress of the lines. Where an obstacle hindered the march dozens of the medium sized ants would make a living filler of their bodies, over which the rest would pass in greater ease and comfort By night the nurse ants and all the rest were safely in the foundation that they had picked for their transient visit The nurses could be seen forming a dense network of their bodies, among which the eggs and young were being kept safe and warm, while all about their camp, others rushed here and there, scouting and policing the grounds in a general clean up of the surroundings.

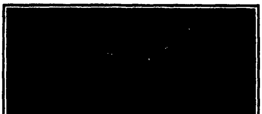
The ants stayed here all night but by morning they had gone on into the forest This army was simply moving The command of instinct had decreed a march only No hunting was to take place and so the whole great tribe moved forward in a thin line without a glance from side to side Such is the marvelous discipline of instinct

When the command says hunt, everything changes. The milder attitude of the multitude changes instantly Every ant becomes a ferocious demon, a fiery reckless and merciless creature that will attack anything and give its life if the necessity arises They launch themselves into the forest in great networks, that gradually enclose certain areas, and every living thing that is weak as well as many of the stronger ones, fall before the onslaught

If one is traveling through the forest, a certain sign of presence of a hunting army, is the calling and chirping of a number of different ant-thrushes, and other birds that have banded together into a flock. These birds follow the armies, partly because of the insect life that is stirred into panic, and partly because of the tit bits of refuse that the army leaves, in the form of legs and other parts that have been torn from the victims.

When such a flock is heard, a few minutes' hunt will reveal the army at its deadly work, while at other times one will know well enough that the lines have been crossed by the severe and thorough biting of one's legs, followed by a painful stinging that causes one to take to the trail in haste to remove the energetic insects. Once they bite into the skin their jaws become quite tightly locked so that it is often necessary to pull them apart, and the Indians use them for closing wounds, by causing them to bite, after which they sever the heads from the bodies.

During these drives, every insect is frightened from cover and instantly pounced upon by as many individuals as happen to be near They actually tear the victim limb from limb and it is then taken to the nest for that day, in many fragments. Almost as soon as an ant has secured a portion of food, it ceases its wild



Front view, greatly enlarged, of a warrior ant, showing the powerful nippers

blood thirsty actions and goes to the rear, its duty accomplished.

If a large insect such as a grasshopper or a big jungle roach is thrown among the ants, it will eventually be vanquished by sheer weight of numbers. As it lands among the warriors, one or two will lock their jaws upon its legs with lightning rapidity The sufferer will now hop or fly in agony, but the instant it lands again, several more ants will grab its appendages. This procedure soon weights the victim to the ground permanently, where it is torn to shreds without delay

Ants returning to the rear often assist one another in various ways. As it is usually the custom to straddle one's booty on the homeward journey, the ant is frequently greatly hampered by the size of the cut. Again a long caterpillar may be the victim, one that has been left intact, owing to its slight resistance, and thus becomes a great burden In these, and similar cases, ants were observed to come to the assistance of their sisters They would help drag the meat along or hold the abdomen of a sister up out of the way, and in one case two ants were seen to straddle a caterpillar and thus carry it along on their tall legs, like so many laborers carrying a railroad rail or a big log.

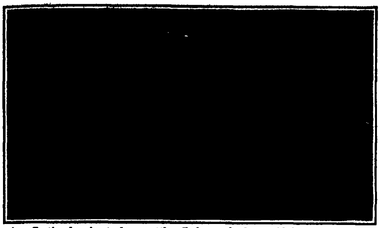
Birds and animals are not immune to the attacking ants, especially young ones. In fact any animal would soon succumb to their myriad bites if there were no avenue for escape One realizes how great are their numbers when a distinct and strange rustling murmur reaches the ear, due to the thrashing about of countless bodies.

Some creatures have learned to escape Thus the smaller species of spiders, leap from their perches at the approach of the ants and remain safely suspended upon a silken thread until the danger is past. On the other hand very large snakes are sometimes killed and devoured, before they can get beyond the lines of the army

The entire tribe does not take part in the drive for food. A large number of workers remain at the temporary nest to care for the eggs and young while the warriors are away, and swarms of workers also cluster the entrance so that it looks like a brown furry vegetable growth, from a short distance As the burdened hunters return, they are carefully brushed and combed by the workers, and their booty is dropped and carried into the nest by these individuals also. The actual passage to the interior is lined thickly with a network of ants so that every individual must pass along a living passage to gain entrance.

The Indians of Guiana like those of many other South American countries and also the Bovianders and white people, have learned to respect the army ants because of their house cleaning propensities. Every house, from the rude thatched benab of the Indian to the solid wooden ones of civilization, are more or less infested with very large roaches, and other insects, and also huge tarantulas, which come only to obtain the roaches. None of these things are liked by the average human being, but the army ants are fond of all of them. They come not infrequently, in tremendous armies, to the abodes of man, and in the course of a few hours leave them cleaner than they have ever been before

In these great tribes there is but a single Queen Her sole duty is egg-laying after the colony is once started and she is given the most exquisite care all during her life She is sheltered and watched and attended like a real Queen and no harm can easily come to her Periodically, a brood of young Queens and males are hatched. These individuals are winged and as soon as they are mature, all of them leave the tribe in what is called the marriage flight. Each Queen finds a mate, They pair and the males soon die afterward, but each young Queen founds her own new tribe and after bringing up the first workers herself, this little crowd set about to rear about themselves another great gypsy band of army ants.



An effective barrier to keep cattle off the tracks is provided by this uneven assembly of rollers

Scaring the Cattle Off the Tracks

MUCH interest is attached to the recent development of a conical roller cattle guard that it is believed will prove effective in preventing stock from passing. There are four sections, one of which is placed outside each rail and two between the two rails. Each section is composed of conical wooden rollers three inches in diameter at one end, four inches in diameter at the other and twenty-four inches long. Four steel side and end pieces bolted together constitute the frame, by means of which the guard is spiked to the tie. The rollers are supported on metal rods on which they rotate.

As animals approach the guard they are alarmed by the irregular and strange appearance presented by the alternating conical rollers and many do not come any nearer. But if they become bolder and advance up to the guard so as to place one foot upon it, the rollers revolve underneath their feet, and most animals will immediately leave. Where the animal puts one foot upon the rollers and, still unalarmed, tries to advance with another foot, his weight rotates the rollers under his foot and he will find it impossible to proceed.

A Clever Job of Continuous Packing

AN interesting apparatus for the mechanical packing of tea is to be seen in a San Francisco factory. An overhead track system supports a unit of six traveling bins, which can be shifted so as to bring any bin directly above the chute, *D*, that leads to the weighing scales. In this way any number of cans can be packed with any desired type of tea, and a shift made as often as the orders of the day require, or special blends can be made with a minimum of trouble. The overhead system is operated by a drum-wound cable, and any bin can be brought into the dumping position in a few seconds. The bins themselves are kept supplied with tea from larger storage on the floor above, to which they are open. There are six bins, and only five brands of tea to be packed, so that at all times a bin is "left over," and can be filled from above while one of the other bins is losing the last of its contents to the packing machine. In this way tea can be kept running continuously, with never a failure of the supply of any brand and never an empty bin. We have seen numerous applications of the idea of continuous packing, but none that seemed more generally effective than this one.

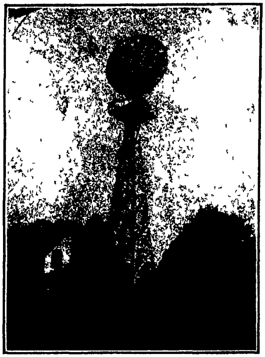
Movable bins on an overhead track add flexibility to this tea-packing outfit

The Wind-Power Automobile

AN automobile whose operating expense includes no provision for power might seem as though it should go in the class with the mysterious green fluid that makes gasoline out of water—it certainly sounds like a crazy dream or an outright fraud. Nevertheless Mr. A. I. Root, the dean of the American bee industry and publisher of *Gleanings in Bee Culture* has such an automobile at his winter home in Florida.

The answer is a pair of busy windmills. The car is an electric. The mills are two in number, 16-foot wheels on 60-foot towers. Instead of having a counter-shaft or a set of gears to multiply the speed of the wheel to the necessary dynamo speed, the dynamo is mounted on the platform immediately beneath the wheel and connected by means of a belt running clear around the circumference of the wheel and then directly to the generator shaft. To provide for varying weather conditions an idler is used to take up the slack of the belt. The belt itself is made of a specially designed fabric which meets with complete success all the weather conditions to which it is exposed. Whether it would fill the bill in a more rigorous climate is not stated, but the mill is manufactured in North Dakota and widely used there for farm lighting, which suggests that blizzards are a mere incident in its life. The generator is mounted on a revolving platform and goes with the wheel as the wind shifts. The cost of a single mill with switchboard and all other apparatus but without a battery, was given, at the time of writing, as $1500. We think it probable that today it would be somewhat less, but whether the reduction would be a material one we cannot say with any degree of certainty.

It is a familiar experience with users of the gasoline automobile that it is not an economical means of providing small units of transportation. Many cars are employed for little more than the daily drive to the station and back, a run of at the most five to six miles. Cars that develop 20 or even 25 miles per gallon on longer runs are barely warmed up to their work at the end of the run to the station, and give this sort of service at excessive fuel cost. The electric is an ideal vehicle for work of this character, if the work of charging can be done without paying an excessive profit to someone. For charging from a windmill, as light a machine as possible should be secured, with a small battery that does not make much if any more than 25 miles on one charge. A light battery, charged little and often and kept full, is the thing for this usage. The automobile is to be left in the garage and connected with the dynamo all the time when it is not actually on the road. A cutout, similar to the one between battery and generator on the ordinary gasoline cars, must be provided in order to insure that at low speeds or when there is no wind at all the battery shall not discharge through the dynamo. This cutout is operated magnetically, and breaks the circuit leading to the battery whenever the dynamo is not turning over at a predetermined rate. Contrary to what the non-electrician might expect, such cut-outs are neither complicated, nor likely to get out of order.



This windmill and another like it drive the family car about six miles per day, and light the house in addition

Mr. Root, from his two windmills, keeps his car fully charged for its regular duty of five or six miles per day, and in addition lights his house. He finds that a single windmill operates rather fitfully, but that with two going at once, even when they stand close together, the wind is sufficiently capricious to insure that one will usually be running at charging speed even if the other is not. Aviators will confirm the inference that considerable variations in air movement are met between points only a couple of hundred feet apart. With his two mills connected up, Mr. Root finds that the charging curve is entirely smooth enough for all purposes.

A Lilliputian Piano

AMONG the attractions of one of London's amusement places is the miniature grand piano illustrated. Exact dimensions are not given us, but the finger of the user affords a very good approximate scale by which the actual size of this tiny musical instrument may be estimated. In spite of its Tom Thumb appearance, this piano can be played in the usual way by one with sufficient control of his fingers. The extent to which the editorial digits find the wrong key on the editorial typewriter make us wonder what kind of a finger this would be, but that does not alter the fact that the piano can be played, just like any other piano by anyone able to play it. Perhaps, as in the case of some of the string instruments, one picks at this keyboard with an artificial finger-end.

Speaking of baby grands—here is one from a London amusement hall

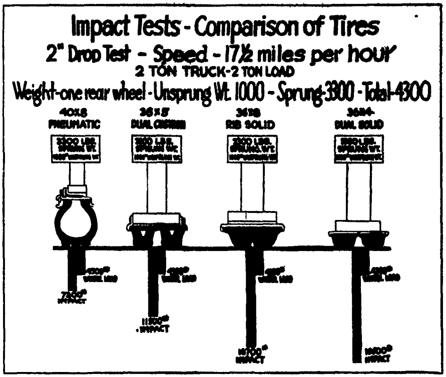
What Happens When the Tire Hits the Road

Studying the Impacts from Pot-Holes and Obstructions, with Different Types of Tires

WHO IS destroying America's highways? The road engineer, the truck driver, Jack Frost the politician, the speed demon and the road builder have all been accused Each pleads not guilty and the roads go right on disintegrating Now the United States Bureau of Roads is attacking the question with every prospect of getting an answer The investigation deals with road surface, road structure sub-surface drainage, and traffic Of permanent value are the findings under the first three heads, but of paramount interest at the moment are the results of the examination into the traffic, and what it does to the road

Most significant of the findings is that it is not chiefly the dead weight of motor trucks that destroys the highway If a truck strikes an obstruction on the road, or if it runs into and out of a pot hole, the wheel comes down on the road with a thud It is this impact that does destruction, crushing the surface and breaking the foundation

This impact can be measured as a function of truck weight, of truck speed of load per unit of wheel bearing surface, of poor design, etc Tons of chassis and freight smashing along the highway strike hammer blows upon the roadway, this is not to be avoided But the force of these blows can be lessened The chart herewith shows some of the results of the study of the problem A solid tired, five-ton truck, operating at 17½ miles per hour with a five-ton load, on striking a two-inch obstacle delivers a blow on the pavement of 29,000 pounds. The same truck with pneumatic tires, may carry an extra ton of load and under the same circumstances deliver a blow of only 11,900 pounds.

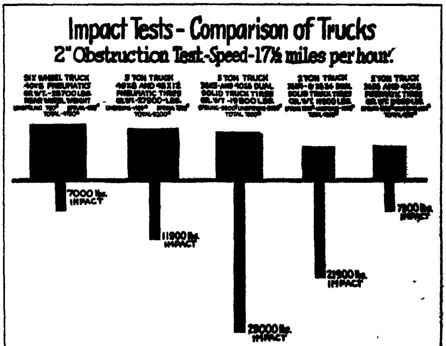


The blow delivered to the road when a two-ton truck, with a two-ton load, runs into a two-inch hole or rut, depends very largely upon the type of tire carried. At lower speeds the difference would be less, at higher speeds more, in favor of the more shock-absorbing tires

Does this indicate that all trucks ought to be shod with air? By no means. Impact varies with the speed and the load carried Take the coal dealer delivering in a business district The extreme weight of the truck and the load restrict the speed to very moderate figures, and the heavy traffic has the same effect Comparatively little cushioning is necessary to protect the road and the truck from the jars of impact at these low speeds, so a solid or cushion tire, with its greater bearing surface is advisable to distribute the dead weight of the load over more of the pavement As the load goes down and the speed goes up, the demand for cushioning gains in importance and that for distribution loses Then we may replace one or both pairs of solid tires by the cushion type, combine the cushion with the pneumatic, or, finally, mount four pneumatics But on all trucks up to a limit of 2½ to 3½ tons, where a wide range of operations is an important factor the big, fast, easy riding pneumatics are highly desirable

There is a right and proper and economic tire for each set of conditions. Knowing the condition—the road, the load, the service to be rendered by the truck—one may follow the diagrams of the Federal engineers and diagnose with a high degree of accuracy the truck owner's needs. Particularly suggestive is the finding with reference to the impact from a six-wheel truck Obviously, with six wheels, the load per wheel is less and the impact per wheel less but one would not necessarily be prepared for such a difference as the chart shows. To the layman, in this connection, it may be necessary to point out that six impacts of 7000 pounds each, even if they all come in the same place, will not do the damage that will accrue from four blows, of 11,000 pounds or a bit less each Conceivably, the road might stand up indefinitely under the lighter blows, and disintegrate rapidly under the heavier ones. Hence a lightening of the blows, by greater cushioning, or by multiplication of wheels, or by any other means, works out into a saving of road repair costs quite disproportionate to the cost of the better trucking practice.

Comparing the three types of tire, it seems easily susceptible of proof that the pneumatic has greater cushioning, can be operated over an open stretch of road in a shorter time, and does less damage to road and vehicle, than either of the others. There is a point where the possibilities of time saving, and the need for cushioning, become so small that it is no longer economical to use the pneumatic tire. Slow-moving freight will probably continue to be carried on other types of tire. But the practice of short-sighted truck-owners, of economising on tires at the public expense as measured in road destruction, cannot go on indefinitely The graphs of the Federal engineers give ample basis of proved fact for taking any necessary steps to insure that trucks be properly shod for the loads that they carry and the speeds that they attain.



The United States Bureau of Roads, in addition to the "jumping-off" impacts of our first drawing, has also studied what happens when the moving truck hits an obstruction. The difference here is even greater in favor of the more efficient tires than it was in the drop test

The Senses of Insects

IN the last report of the Smithsonian Institution (1922) Dr N E. McIndoo has an interesting article on the senses of insects. After discussing the nature of insect vision, both by simple and by compound eyes, the author proceeds to the sense of smell, and considers it first as a means of recognition This sense is far more developed in insects than in man, yet Dr McIndoo found that by smell alone he could distinguish the three castes of bees as well as other components of the hive. It is probable that each individual bee has its peculiar odor, but it is the combination of all these that makes up the hive odor and this is regarded as the most important and as indeed the ruling power in a colony It is a means of protecting the social life of the bees from without, and the queen odor which is a part of it insures continuation of the social life within. The workers "know" their hive-mates by the odor they carry This insures harmony and a united defense against attack. The queen odor constantly informs the workers that their queen is present. Even though she does not rule, her presence means everything to the bees in perpetuating the colony Thus, by obeying the stimuli of the hive odor and queen odor, and being guided by instinct, a colony of bees could not want a better ruler Among ants the same broad principles hold, but here the family odor is the more important.

What, then, are the organs by which insects recognise these odors? Dr. McIndoo has identified them as small pores scattered or grouped on the body and appendages. A nerve ends in each pore, and the opening is often protected by a hair. By covering the pores, experimental proof of their olfactory function was obtained.

That bees, among other insects, can discriminate between foods is well known, and that their power of discrimination exceeds that of man was experimentally proved by Dr. McIndoo. He ascribes this power, however, not to taste, but to smell. Taste and smell are closely allied, and it is possible that the only difference lies in the organs that respond, the stimuli themselves being identical. In bees, there appear to be no such organs connected with the alimentary tract, so that the discrimination is probably made by smell.

Mail dropped in this box in the country is collected in the city, to the great expedition of its handling

A Traveling Post-Box

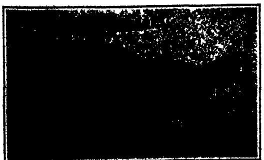
RURAL free delivery is not the only means of extending the scope of Uncle Sam's service to communities and isolated houses off the main line of communication. The latest idea for making the mails more useful involves the mounting on interurban trolleys of ordinary mail boxes. At any point along the line letters may be posted in these boxes to be removed by the postman when the car reaches a good sized town. This is a long step forward from the condition where the people strung out through the country are dependent upon the once-daily passing of the mail carrier for their contents with the outer world.

Motor Propulsion for the Legless

HIMSELF a cripple through an attack of infantile paralysis, a member of one of New York's oldest families has invented the legless automobile which we illustrate. Though the user is seen with trousers and shoes his legs are useless to him and any means of navigation which he employs must be one that can be entirely controlled with the hands. The conventional wheel chair did not appeal to this particular man and he displayed a touch of inventive genius in designing a motor-driven substitute. It is in fact in every detail worthy of the designation "automobile" save only that its dimensions are a bit nearer those of the motor cycle. It is but 32 inches wide and 70 long. It also strikes nearer the cycle than the car in that it has a single front wheel, steered by bar rather than by wheel. The other controls are for the larger part assembled upon the handles of the bars where they are easily accessible.

Airplane, or Plain Flivver?

WHILE M. Barbot and his aerial flivver are in the public eye seems a good time to put on display another kind of airplane flivver—one actually built upon the foundation of a Tin Lizzie chassis. As the picture makes clear this plane is designed for advertising purposes and not for flying and it does all its running with four wheels on terra firma. Nevertheless its body is built on exactly the lines of a regulation airplane, even being equipped with rudder and elevators. The rudder gets a practical touch by serving as a direction indicator to the driver behind and for this end it is connected by cables with the steering gear. The car is equipped with port and starboard lights and the propeller can even be driven around by the engine.



This airplane-style body is the latest model in fancy flivvers

Gas and Oil on the Fly

ONE of the things that plague the long-distance record seeker on road or on track is the stop for supplies. When a tire replacement is in order there seems no way out, but a recent performance on the Indianapolis Speedway demonstrates that stops for gas and oil are simply a matter of habit. The distance for the run was determined in advance, being set at 3155 miles—the distance from New York to Los Angeles via the William Penn National Old Trails route. All service aside from the tire replacements was achieved from a second car, which took the track and kept pace with the racing machine at a speed of 50 miles per hour. Inasmuch as the car under test finished the distance in 21 minutes over an even 50 hours at an average speed of almost 63 miles per hour, it will be seen that the 50-mile filling speed represented a distinct slowing down on the part of its driver. Our photograph shows the process of filling gas into the tank of the racer with the mechanician attending the business end of the hose.

The Heating Value of Gas

TECHNOLOGIC Paper No. — of the Bureau of Standards, for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 25 cents a copy, gives the results of laboratory tests conducted at the request of the Public Service Commission of Maryland on the relative usefulness of gases of different heating values and the correct adjustment of burners for changes in the heating value and specific gravity of the gas.

There was a time when gas was used almost exclusively for lighting purposes and in the ordinances regulating gas companies it was usual to require gas having a certain illuminating value. More recently gas

Motor travel for the legless, in a machine that is controlled entirely by hand

has been used more and more for heating purposes and less and less for lighting, or when used for purposes of illumination, it is almost always burned in a mantle burner. This was accompanied by a change in most regulations from an illumination to a heating value basis. Still more recently it has been found necessary in some cases to reduce the heating power of the gas due to increased cost and other difficulties of manufacture.

The present paper deals with a condition thus brought about the tests having been conducted primarily to determine whether the consumers in Baltimore were getting as good gas service with the present standard of 500 B.t.u. per cubic foot as they obtained with gas of a higher heating value in former days. The tests showed that with proper adjustment of the appliances the service should be equally good. The relative cost of the service however under the two conditions was not taken into consideration in this report.

Wave-Length Measurements in Arc Spectra

COMPOUNDS of the rare earth elements which are used extensively in the manufacture of gas light mantles and cored carbons for electric arcs and less extensively in the textile and glass industries for their coloring properties, are about the most difficult salts for the chemist to prepare in a pure state. The chemistry laboratory of the University of Illinois has succeeded in preparing some of the members of the rare earth family in a high degree of purity and has submitted to the Bureau of Standards samples of these materials for spectroscopic analysis. The work on the original consignment of materials is now completed and Scientific Paper No. 466 has just been issued describing the results that have been obtained for the two elements gadolinium and dysprosium. Two preceding

Filling a racing car with gas and oil at fifty miles per hour

papers have dealt with yttrium, lanthanum and cerium and with neodymium and samarium. The spectroscopic analysis confirms the degree of purity attained by the chemists in separating the gadolinium and dysprosium salts from the original materials and in addition yields an accurate description of the green, yellow, red and infra-red spectral regions of these elements which have only been covered incompletely heretofore.

The data collected from the observations are compiled in two tables one of which contains about 950 wave lengths in the arc spectrum of gadolinium and the other about 800 wave lengths in the arc spectrum of dysprosium. These data are of value chiefly to chemists who are interested in problems of analysis, to astronomers who are concerned with the chemical composition of the stars and to physicists in connection with atomic structure. This paper can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

A Novel Instrument for Navigators

USING the spherical angle calculator illustrated herewith it is claimed that the data necessary for proper utilization of the gyro compass are obtainable with a greatly increased facility and a vessel's position determined from a single observation. What this instrument really does is to set up in the form of a small model the various astronomical and geographical circles with the position of the ship with reference to them, whereupon zenith distance and azimuth are read off the zenith circle and the dial and the ship's position is known almost without calculation. The really difficult part of the customary calculations is the part replaced by the automatic reading of the instrument.

In the photograph C represents the earth's axis. It is journalled to the declination circle B and securely fastened to the latitude circle C. At D the center of the compass rose we have the ship's position—which is of course unknown to begin with and which gets determined only as the setting of the movable parts of the calculator to match the observations made determines it. The semi-circle F is the zenith distance circle and incidentally represents also the ship's meridian. The correspondence between the model and the visible universe with the ship in its center is obvious.

A spherical-angle calculator that does much of the navigator's hard work for him

This man is careful wears jacket inside overalls wears tight gloves carries electric cap lamp

This careful miner has blocked the car with a piece of timber He does not trust to the brakes alone to hold the car in place

Miner testing roof as he approaches a fall in his room. He detects loose material by its vibration

Snapper, running ahead to switch, catches his foot in open frog. A wooden block in frog would prevent this

Some incidents in the life of the coal miner which make for safety or danger

Safeguarding the Miner

Safety-First Cooperation of the Bureau of Mines, the Operators and the Miners

WHEN several mining disasters, such as those which followed the last miners strike, occur, we must be careful not to draw the conclusion that mining accidents are on the increase or that no precautions are being taken to prevent them As a matter of fact although the great mining disasters powerfully excite public apprehension, there has been an encouraging reduction in the number of major disasters and deaths in coal mines since 1911 In that year 15 coal-mine accidents occurred with a loss of 413 lives, whereas in 1920 eight similar accidents resulted in only 61 deaths, and whereas in 1911 major disasters caused 15.5 per cent of the total killed at coal mines, in 1920 only 2.7 per cent of the total deaths from all causes were due to major disasters. Now the credit for this improvement is due to the preventive work done by the United States Bureau of Mines We are told by its Acting Director, Mr H Foster Bain, that 12 years ago there was no general country wide service for the systematic training of miners in matters relating to safety a slight beginning only having been made in a few scattered points. There was no such urgent need for training in those days, for so long as the mines were small and the workers intelligent and well trained in routine mining methods, and when the pressure for output had not yet speeded up the industry to its present pitch, it sufficed very well for each man to look after himself and for the bosses and superintendents to rely upon improvised methods when major accidents occurred.

But when the enormous expansion of coal mining brought about the introduction of new and little trained labor, and when the scale of production was so greatly increased there was a rapid rise in the dangers of mining The increased output in the mining of today has been obtained from the substantially same number of miners as ten years ago but the personnel is not nearly so well trained in mining There was a series of disasters and mine explosions immediately prior to the organization of the Bureau of Mines and the problem before the Bureau was that of reducing the number and severity of these To this end the Bureau of Mines sought the cooperation of the State Mine Inspectors, the mine operators, and various other agencies, and while the full benefits resulting from preventive and remedial measures cannot be gaged accurately by figures only the statistics, as given above, show that greatly beneficial results have been obtained

When the work of obtaining records of the injured at the mines was undertaken by the Bureau in 1911, many of the States kept no record of such accidents, and the record shows a small number of injuries reported to the Bureau during the first few years after 1911 The apparent increase in injury reports, which was noticeable from 1911 to 1916, was due in a large measure to State requirements for reporting such injuries and to the rapid enactment of compensation loss by many States during that period Today mine operators in practically all States must report non fatal injuries. The Government now obtains accurate statistics both of deaths and injuries They show that the number killed per thousand persons has decreased from 4.86 in 1911 to 3.66 in 1920 Of late the injury rate has ranged from 234 to 242 per thousand men employed.

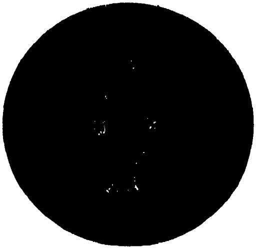
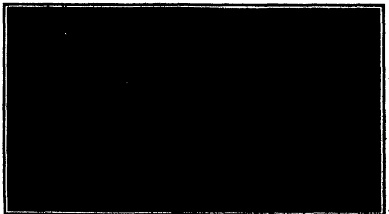


Diagram shows the injuries to various parts of the body in the proportions revealed by the accident statistics

A very effective agency in reducing the number of accidents and mitigating their effects upon the injured, is the character and extent of the training which is given to those engaged in mining Miners who receive certificates of first-aid training are instructed and examined in the anatomy of the human body, the treatment of hemorrhage, fractures, burns and shock, and the transport of wounded persons. Certificates of rescue training are given those who pass a physical examination, who wear breathing apparatus while doing hard labor in atmosphere containing noxious and irrespirable gases, and demonstrate their ability to adjust and take care of such apparatus and to perform the duties of rescue men The course of training represents a total of 15 hours of intensive work. During the decade ending June 18, 1920, the Bureau of Mines trained 50,971 persons in rescue and first-aid methods. In 1911 the 734 persons trained represented less than one miner in every thousand, but in 1920 the number trained was 8008 which represented nearly ten miners in every thousand employed.

As regards the causes of coal-mine fatalities, it should be noted that nearly half of all deaths at coal mines results from falls of roof and coal, and most of this class of accidents take place at or near the "working face," which is the place where the miners actually mine the coal A few occur elsewhere in the mines, as on slopes and haulage ways. Many of the falls at the "face" are due to failure of the miners to take down loose rock or coal or to set props under dangerous places in the roof.

Mine cars and locomotives underground are responsible for about 17 per cent of all fatalities, the victims usually being run over or caught between the cars and side of haulage way



Switch handle is carried back into whitewashed hole in wall. The man is clear of the haulage way and in a safe position

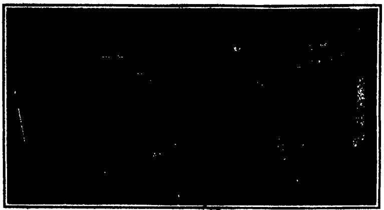
It will surprise the public to learn that mine explosions, although generally given much prominence in the daily newspapers, have caused only a little more than one-tenth of all fatalities during the past decade, and, excepting 1922, the percentage in recent years has been considerably below that mark. Most of the gas explosions have been caused by the carrying of open lights into accumulations of gas, while the explosions of coal dust have frequently resulted from windy or blown-out shots or to what, in the absence of dust, would have been local explosions of gas.

Accidents due to powder and other explosives have caused six per cent of all fatal mine accidents, between three and four per cent have been due to electricity, and less than five per cent to miscellaneous causes underground.

Of all fatal accidents at coal mines, about 90 per cent have occurred under-

ground, between two and three per cent in shafts and slopes, and slightly less than eight per cent above ground

A most important part of the safety first campaign of the Bureau consists in the publication, from time to time, of circulars illustrated by photographs, which show the miner, and the operator also, what he should do and what he should avoid in the prevention of accident and the safeguarding of life and limb The excellence of this method is revealed in the half dozen photographs, which we have chosen from a circular issued in 1919 entitled "Dangerous and Safe Practices in Bituminous Coal Mines." These have been chosen from 200 similar photographs which make up the bulk of the circular Each has beneath it a few explanatory words, and even without these the pictures themselves should convey a clear lesson to that large proportion of the miners of today who cannot read English and are, therefore, particularly liable to injury



This miner has set a prop under the loose lip before starting work with his pick

The pictures here represented are selected from those which teach the miners the principles of self-protection through care and forethought, and of these there are some 180 in the pamphlet referred to In addition to these there are about a score of pictures which illustrate good practice in the equipment and oversight of the mines, such as the provision of miscellaneous safety devices, among which may be mentioned an underground machine shop, sub-foremen's offices which are kept locked, but with telephone, first aid box stretcher and skeleton map of mine so placed that they can be reached from the outside, locked explosive magazines, accident bulletin boards, on which an accident which occurs is recorded for a warning to the miners, safety mottoes placed conspicuously at the roof of the mine, and many similar devices.

Enough has been said to show that this governmental work is highly humanitarian, that it has already, in a single decade, gone far toward making mining a reasonably safe occupation, thus robbing this absolutely essential industry of the terror with which it has too long been associated in the public minds.

A Diminutive Electric Tractor

HERE we have two views of a diminutive and ingenious tractor which for work performed in proportion to its size is certainly remarkable It was built in Germany in response to the urgent demand for the exercise of all possible economy, particularly in the matter of transportation of materials for short distances in large industrial plants. Special effort is being made to replace manual labor by mechanical drives of one kind or another, and it is considered that these conditions are well met by this little machine which is called in Germany an "electric horsetractor"

The complete tractor as shown in the larger engraving consists of a steel frame carried on two wheels provided with solid rubber tires. The accumulator battery is in two parts, one carried before and the other behind the axle. Above the axle is mounted a little 3.6 horsepower motor, which drives it by means of gears, a chain, and a worm drive. The speed is low, being only 3.28 feet per second The operator walks between the shafts, on one of which is mounted a controller, and he steers the tractor and keeps it on a level keel so to speak For security, two small rollers are attached, one in front and one behind the tractor with a small clearance above the ground. The advantages of this little vehicle are found in its small dimensions, its low weight and the ease with which it is handled Also it has proved to be very economical, operating at low expense The ordinary capacity of the battery is 32-kilowatt hours for three hours of discharge but a single charge is sufficient for two days intermittent operation under the average conditions of work The average tractive effort is about a quarter of a ton with a maximum effort of one ton It can haul up to one hundred tons where the load is running on the level upon steel rails on average undulating highways it can haul about ten tons, and running on the banks of a canal can haul 400 tons of load in boats or barges. The tractor is 3 15 feet wide, 2 92 feet high and the length over all from the front hook to the end of the shaft is 12 78 feet. The total weight is about two tons.

Industrial Use of Powdered Coal

POWDERED coal has been successfully applied and is commonly used in open-hearth furnaces bushelling and puddling furnaces, continuous-heating furnaces for blooms and billets furnaces for heating reheating, and forging, annealing furnaces for malleable iron and steel castings and plates, sheet and pair and annealing furnaces and tin pots, galvanizing pots, soaking pits, ore roasting and volatilizing, copper-ore roasting and smelting, the zinc industry the gold and silver industry calcining kilns, lime burning refractory materials and also in the fertilizer industry It is used more than any other fuel in the cement industry and has been successfully applied for steam raising Whenever powdered coal has displaced hand firing the coal consumption has been reduced considerably

By the term powdered coal is meant coal subdivided so that it may be burned in suspension when mixed with the necessary supply of air and may be conveyed easily by means of a screw conveyor, by compressed air, or suspended in a stream of low pressure air to the furnace

The principal advantages over hand and stoker firing lie in the comparative ease of conveying coal to furnaces and in the practically complete combustion of the coal, with little excess air, in close contact with the material to be heated, thus avoiding the convection, radiation and excess-air losses which accompany hand or stoker-fired furnaces placed outside reverberatory and many other furnaces For this reason the most successful field of use for pulverized coal installations has been for those purposes where they have replaced externally fired furnaces. For purposes such as steam raising, where the burning coal can give up heat directly by radiation to the boiler heating surface, there is therefore less opportunity for reducing the fuel consumption by burning powdered coal instead of burning coal on a grate, since the losses which may be reduced by substituting powdered coal firing for hand firing or stoker firing are those only which are due to incomplete combustion and using excess air These losses, however, are not inconsiderable

Certain drawbacks to the use of powdered coal are cited by the author of the bulletin Before powdered-coal firing can compete successfully with grate firing it is obvious that the gain due to the smaller consumption of powdered coal must offset the cost of preparing, conveying and burning it

There is a further disadvantage with powdered coal In grate firing the ash is left on the grates and in the ash pit But with powdered coal the ash is blown into the furnace out through the stack, and with some badly designed furnaces out through openings in the furnaces It may also form a troublesome slag, and fill up the flues so as to impede the draft

On the whole, powdered-coal plants cannot be said to be clean There are fairly clean powdered-coal plants, but generally, though not universally a plant using powdered coal is dirtier than a grate-fired plant

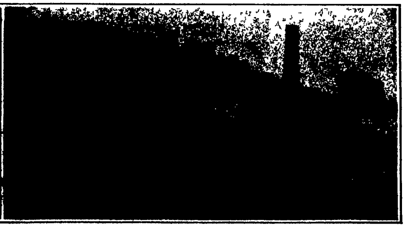
Powdered coal is better adapted for firing stationary water tube boilers than other boilers. With these boilers furnaces of sufficient size and of the correct shape may be constructed, and the gases pass through no tubes wherein ash may settle to obstruct the draft and shield the heating surface It has been found difficult to burn powdered coal in locomotive and cylindrical marine boilers because the combustion space is too small to permit the coal to be burned completely

Although men have been killed by explosions and fires in powdered coal plants, the causes of such accidents are known and precautions may be taken that they may not recur Greater precautions are required with some systems than with others. For instance, dangerous fires and explosions have occurred more frequently with the direct low pressure air system of transport than with the indirect screw-conveying or compressed air transport systems, although the indirect transport system has not been entirely free from disasters. The possibility of a dangerous fire or explosion in a well-designed well managed powdered-coal plant is remote and should not influence the prospective user of powdered coal against installing it

Mincing Microbes

A MACHINE for killing microbes by the simple method of cutting them into bits is described in the *British Medical Journal*, which states that by this means inoculations against infectious diseases may be made with germs from which the poisons have been removed. Thus if detoxicated vaccines are used very much larger doses may be administered with increased chance of protection from the disease Although microbes are so small that 5,000,000 of them in a mass are invisible and a billion are only the size of the head of a pin, this electrically driven machine will cut or smash them The microbes are suspended in a liquid and forced against 70 small knives at a speed of 60 miles per hour so that 28 000 000 cuts are made in one minute As the germs remain in the machine 20 minutes, they receive 560 000 000 cuts.

A two-ton pony tractor



Tractor hauls loaded cars on the rails

The Maple Sugar Industry

The Tree that Made Vermont Famous, and How its Delectable Juice is Harvested

By C. O. Ormsbee

MAPLE syrup is a product of the sap of the maple tree concentrated by evaporation to a boiling point of 219 degrees. At this temperature one gallon of maple syrup weighs 11 pounds, and, including very small percentages of various other solids, chiefly of mineral origin, contains 65 per cent of sugar and 35 per cent of water. Maple sugar is a product of the same sap, so concentrated that, upon cooling, it will crystallize and form a solid mass. Maple molasses is a form of glucose resulting from the disintegration or reversion of maple sugar, when concentrated to a low degree. Maple cakes, maple cream, maple powder and various other pure maple products, consist of maple sugar, variously manipulated, and at various temperatures. And maple blends are syrups produced by the melting of maple sugar, cane sugar, together with water in various proportions.

Maple sap is obtained by wounding the maple tree. This operation is termed tapping, and while there have been various forms, the method which is now in universal practice is to bore a hole, not exceeding half an inch in diameter, to a depth of from two to three inches, at a convenient height, and in a sound, healthy portion of the trunk of the tree. A metal, tubular spout, so constructed as not to interfere with the flow of the sap, is driven tightly into the tap-hole, and a bucket made for the purpose and usually of tin is suspended immediately below the spout. The sap, being forced from the tree by internal pressure, trickles through the spout and falls in little droplets into the bucket below. The buckets usually have a capacity of from 12 to 16 quarts, and it is rarely the case that a sufficient quantity of sap flows to more than fill a bucket during the 24 hours which intervene between the times of gathering. Many maple sugar makers make a practice of tapping the larger trees in two or more places, claiming that a greater amount of sap is thus obtained.

Botanists recognize something like 100 species of the maple tree as inhabiting various parts of the globe. And it is a common characteristic of all of them to yield this sugar-bearing sap if wounded during the dormant period and under certain atmospheric conditions. But, of these, there is but one species that will yield the sap in sufficient quantity and purity and of a sufficiently high sugar content, and that is closely enough associated in large numbers to allow the profitable manufacture of maple sugar. This is the sugar maple, the hard or rock maple of the lumberman, the *Acer saccharum* of the botanist. This tree is found only in North America, and its range extends throughout the entire valley of the St. Lawrence River and its tributaries, where it is the predominating tree, and westerly as far as Minnesota. From Maine it extends southwesterly, well into the Carolinas, thence westerly through Kentucky and Tennessee, well into Arkansas and Missouri, in which states it spreads, in fan shape, over an extensive territory.

The Bureau of Forestry is authority for the statement that there are, scattered over this entire area, approximately 100,000,000 maple trees. A study of the returns of the last census reveals the fact that of this number but 18,000,000 are utilized in the manufacture of maple sugar, and that, even including the sugar equivalent of that part of the product that is marketed in the form of maple syrup, the entire output of maple sugar of the United States falls under 50,000,000 pounds annually. Of this amount 87 per cent is produced in the five states of New York, Vermont, Ohio, Pennsylvania and Michigan. The total output of Canada is around 30,000,000 pounds annually. It is known that but one-third of the available trees in Canada are utilized, while the numbers of non-utilized trees in the unsettled regions runs high into the millions.

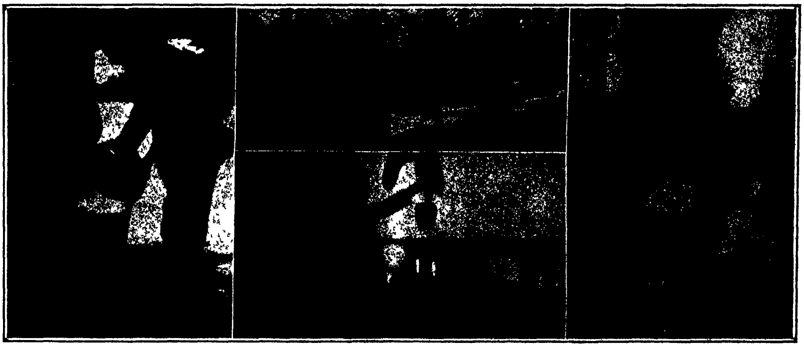
But the maple tree will yield its sap only during its dormant period, and even then only under atmospheric conditions which include bright, clear days during which the temperature rises well up into the seventies, followed by equally clear nights with a drop in the temperature to several degrees below the freezing point. And because in the north these conditions prevail in the highest degree during the month of April, is the chief reason why this is preeminently the sugar-making month in the north. In the south, however, such conditions prevail to a less extent of variation, but over a much greater length of time; and the sugar season covers several months, with light daily yields, but with an aggregate considerably greater than the average yield in the north. The average yield per tree throughout the United States, as shown by the census, is a trifle under three pounds. Yet trees vary greatly in this respect, and a maximum yield of 42 pounds from a single tree has been reported. And the sap from different trees varies in sugar content, from a minimum of scarcely a trace to a maximum of 10 per cent, with an average of close around 3 per cent.

Briefly stated, the theory of the sap flow is essentially as follows: Moisture is abstracted from the soil by means of very minute appendages, termed "root-hairs," and located near the extremities of the smaller rootlets. This moisture consists of an extremely weak solution of the various mineral elements, chiefly in the form of nitrates, which enter into the composition of the tree and form the ashes when the substance of the tree is burned. It is transferred from the root-hairs into the rootlets, thence into the larger roots, and finally into the trunk of the tree, in which it is carried up into the branches and into and through the leaves. During its passage it loses, by evaporation, an immense percentage of moisture, which passes off in the form of a watery vapor, and another immense percentage is broken up into its elements of hydrogen and oxygen. Air is also forced simultaneously through the leaves; and during its passage it parts with the carbon dioxide that was intermingled with it, and emerges as pure air, while the carbon dioxide unites with the hydrogen, thus forming starch. The oxygen thus set free emerges in the form of ozone, the insoluble starch is transformed into soluble sugar, as occasion requires, and forced back into the sap, which henceforth is known as "elaborated" sap, and which forms the food of the tree. In this form so much as is needed for immediate growth is carried to points where new tissue is being made, and the remainder is stored for future use. Then after the fall of the leaves, and influenced by atmospheric conditions already described, this stored sap begins to work its passage toward the exterior of the tree and into the space between the bark and the wood, and in some not well-understood manner a gas, probably nitrogen, is generated, which creates the pressure previously mentioned.

Maple sugar is identical in its composition with cane and beet sugar, and were it refined to a state of absolute purity it would be indistinguishable from them and would possess no more value. But commercially it is never so refined. It owes its superior value to the presence of an elusive essence, of a most deliciously delicate flavor, and which chemists have as yet been unable to isolate. And, contrary to the opinion that is prevalent in many localities, high-grade maple sugar is of a very light, almost white color, and maple syrup is almost transparent in its clearness, with an indescribably smooth and delicious flavor. The dark-colored, viscous syrup so often offered for sale is a low-grade product, made so by the incorporation of caramel and bacterial products developed by careless and unsanitary methods of concentration.

For maple sap, as it comes from the tree, is as clear

(Continued on page 214)



1. Emptying a tree-bucket of its sap. 2. Gathering pails of sap from the tapped trees. 3. Inside the sugar house, showing the great cast-iron boiler or evaporator. 4. An outdoor sap boiler

Glimpses of New England's outdoor cold-weather industry—maple sugar production

Whole Wheat Bread Without Flour

MAN for ages has made bread by several methods—and none of them has been right. The most recent contribution consists in the methods which may be grouped under the term "the modern milling industry." The aims of this industry have been more commercial than hygienic.

An examination through the microscope of a grain of wheat will reveal that there is a white central portion, protected by two envelopes. Between these envelopes is a brown substance. Outside them is the bran, which is not a food substance. The modern flour mill has been operated with the sole aim of producing a white flour, and with this in view only the central part of the grain is retained, the cylinder machinery eliminating the two envelopes and the material between them. But the sad fact is, that in this space between the envelope lies the major part of the nutritive value of the berry, and all its vitamines. All this is discarded in the effort to get a white flour and a white bread.

The test of the vitamine content of food is a simple matter. It has long been known that pigeons, mice, rats and guinea pigs, fed solely on ordinary white bread and water, die from lack of essential elements of the diet. At the same time it is known that the prevalence of rickets and bone diseases among under-nourished humans is to be ascribed to the absence of vitamines from the ration. Because of this lack in the ordinary white bread, one could gorge himself on this food and slowly starve to death.

For many years specialists have been trying to retain all the nutritive elements of the wheat berry, while keeping the bread white and soft. Kneiff made white bread in this way, but it was not soft—it required supernormal teeth for its mastication, in fact. A later scheme, known as the Mege-Mouris method, failed because of the elaborate process of fermentation of the grain which it employed. A new system now put forward in France, however, gives great promise of providing the solution. It eliminates all slow sifting to free the grain of the bran, and in three distinct operations of washing, maceration and sifting, which can be carried on simultaneously, in a machine whose cost is so low as to be within the reach of all it has developed a practical way of conserving the gluten and the vitamines of the wheat.

The washing not only cleans the grain, but makes it easier to crush the bran and peel it off from the kernel that contains the nutritive elements. After the washing, the clean wheat is macerated to bring it to the necessary degree of hydration. Sifting then replaces the ordinary milling process, separating the bran from the pulp and leaving with the latter the highly nutritive portion between the outer envelopes.

The most startling feature of the new process is that its product is not flour, but actually dough. It contemplates the elimination of flour from the domestic economy, and of the flour mill from the industrial establishment. It contemplates that the housewife buy the whole wheat berry just as it now goes from the thresher to the mill, that she pour these kernels into her machine, and receive out of it the dough for her bread. All the nutritive values of the wheat are retained, and the useless and indigestible chaff is discarded at the same time. The machine is no larger than the ordinary family washing machine, and like so many other household utilities it can be operated with the current from the usual electric light socket.

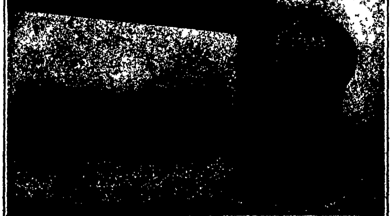
French and English loaves made by the new process, retaining all the vitamines

The main part of the machine consists of a large perforated drum into which the wheat is poured through a funnel. The grain goes through a continuous crushing process inside this drum, accomplished by means of rotating cylinders operated by a four-horsepower motor which produces from 25 to 30 kilograms of dough per hour. While the dough is thus being prepared in the machine, the bran is separated out and falls into a receptacle in the bottom of the drum while the dough issues simultaneously from another opening. The dough is ready for the usual leavening process, and in half an hour may be put in the oven. The bread thus obtained has an agreeable taste, it is not pure white for it contains the inside cover of the wheat kernel. It seems probable, however, that the housewife of today is educated beyond the point where a snow white color stands in her eyes as the hall-mark of purity and quality.

Internal view of the machine that makes dough from the whole wheat berry. The cylindrical drum is removed to show the rotary crushers

While the experimental work has been done entirely on the home-sized model, the new method does not necessarily demand that the housewife make her own bread. The machine will presumably be obtainable in large sizes, suitable for bakeries of every magnitude from the small village establishment up to the factory that makes bread for a city. This factory will derive the same advantage in making bread direct from wheat, and in making bread with all the wheat in it, that the individual housewife would enjoy.

The two figures in the new development are Messrs. Pointe and Navarre, two well known French scientists and engineers.



The drying-time meter, with inset showing a piece of marked film removed from the apparatus after a test of the drying-time of varnish. Note the sharp line at which the tissue ceases to adhere to the film

Measuring the Drying-Time of Varnish

THERE have been disputes among producers and consumers as to the drying-time of paints, enamels, oils, and various varnish products. Many of these have been due to the fact that the method of determining the dryness of a film (touching every hour with the finger) has not been well defined, and especially to the fact that observations could not be made with regularity over the drying period which often occurred late at night. In an attempt to overcome these two factors, Mr. H. A. Gardner of the Paint Manufacturers' Association, has experimented for several months to develop an automatic drying-time meter. Several types were designed and constructed before one that would give satisfactory results was developed.

It will be noted in the illustration that the apparatus consists of an alarm clock device fastened on an upright base. Attached to the hour hand of the clock is a very lightly constructed wire wheel covered with a circular drum formed of light tin plate or of aluminum. The drum is slotted to receive the test piece upon which the coating is applied. This winds under the mandrel rod at the top of the drum and is pressed in contact at that juncture with a sheet of soft light tissue paper of the same width as the test piece. Both of these are automatically pulled from an adjoining double shelf stand, by the action of the clock. Just so long as the coating is wet, it will stain the tissue paper at the point of junction, the paper adhering quite tenaciously to the film. Just at the point of firm setting of the coating the paper will no longer be stained when it comes in contact with the test piece and will not adhere thereto during its subsequent journey around the drum.

The test piece developed for this work after a trial of many materials, consists of a roll of celluloid moving picture film (waste short ends of undeveloped raw stock) that has been light struck but not developed. This material was selected because of its opacity (white silver coated surface) upon which, applied clear coatings are quite evident. Because of its great smoothness of surface, paint and varnish coatings do not penetrate it, but dry upon the surface somewhat as they would upon glass. Moreover, the solvents usually present in paint and varnish apparently do not affect the film, and they seem to evaporate in the same time as they would from tin or glass. Solvents of the ester type, or acetone-containing solvents, such as may be used in lacquers could not be used. Moreover, such film is of a standard size and character of finish and is obtainable in practically any part of the country at a low cost from moving picture firms.

Tarnishing and Detarnishing of Silver

THE Bureau of Standards has recently made an investigation of the tarnishing and detarnishing of silver at the request of the Department of Agriculture. This investigation has shown that the tarnish ordinarily observed on silver is the sulfide film of which certain colors are characteristic and indicative of the extent of the tarnish. The effect of hydrogen sulfide gas by itself on silver is relatively small, but if small amounts of moisture and sulfur dioxide are present the action is greatly accelerated. Tarnishing is also made more rapid by the presence of alkaline films and soap films. Conditions for producing a standard reproducible tarnish were found, and the weight and thickness of the tarnish film were calculated.

In studying the methods for detarnishing silver especial attention was given to the electrolytic methods. Moss silver is produced when the tarnish is reduced electrolytically and the properties of moss silver were therefore studied. Comparisons with other methods were likewise carried out to determine the losses in silver that occur. The relative merits of solutions used for the electrolytic process were compared to determine the rate of cleaning and the possible corrosion of the specimens.

Left: The rectifying switch mounted on the high tension transformer *Right:* Close-up view of the air-condensers that make it possible to read the actual high tension potential across the X-ray tube

Two major electrical features of the new precision X-ray apparatus

Precision X-Ray Apparatus

New Means of Rectification and Voltmetering that Take the Guess-Work Out of Roentgenology

ROENTGENOLOGISTS today are taking increased interest in X-ray therapy. X-ray apparatus which has been offered as an instrument in therapy has not attained the high degree of engineering perfection which our knowledge of the subject warrants. The medical practitioner is able to have his dosages measured with ease and accuracy within one part in a thousand, whereas his brother, the Roentgenologist, has been forced to measure his in almost unbelievably crude guesses.

One of the variable factors that has not heretofore made itself amenable to precise treatment has been the constancy of the wave-form in rectification. We have heard much about the long wave and the short wave rectifiers, but nothing about the constant form of wave rectifier.

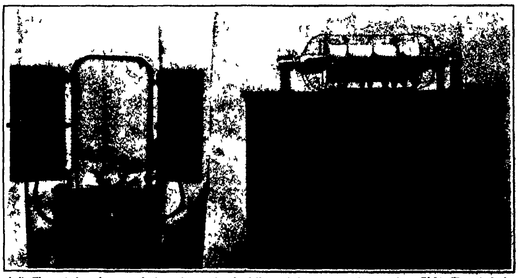
It has been pointed out by adequate authority on numerous occasions that pointed spark gap variations are not alone unreliable because of electrical conditions, such as oscillations, which occur in the circuit, but that they are also greatly affected by atmospheric humidity and by changes in operation as the points begin to wear away. Because of this a strong agitation has been set up for the use of sphere gaps as a means of measuring the parallel spark gap of an X-ray machine, instead of the older pointed gaps. All high tension mechanical rectifiers heretofore constructed have been essentially revolving pointed spark gaps. It is, of course understood that to fit this definition the electrodes do not necessarily have to be actually pointed but that they just have substantially small surfaces; very small balls, for instance, might be substituted without getting far away from the inherently bad characteristics of true points. To get entirely away from these difficulties the surfaces substituted for the points must be decidedly large. The thought which suggests itself is, then, to design a rectifier which has the characteristics of a sphere gap and not that of a pointed gap. By doing this we may not only eliminate the inconsistencies of the needle-point gaps, but at the same time substantially do away with the corona discharge and with the obnoxious generation of ozone and nitrous acid accompanying it.

The practical result of some such line of reasoning as is embodied in the above paragraph is displayed in our first photograph, which illustrates a rectifier newly designed and now on the market. The spheres are stationary, and the revolving spheres have been replaced by "toroidal segments"—to adopt a rather mathematical term—which they in reality generate during that part of their path that covers somewhat less than a full semicircle. A further advantage, appearing on inspection of the figure, is that rods are used for all connections. With the spheres for the stationary electrodes and the segmental toroids for the revolving ones, then there is no place for corona discharge into the air, and no current is conducted through the shaft.

After we have introduced a rectifier that meets our requirements, the next thing is logically to think of means for accurately measuring the energy developed. The sphere gap cannot be used as a measuring means, with accuracy, where the circuits have large charging currents. Further, the sphere gap when used as a voltmeter requires such skill as to introduce a considerable personal equation. It is not possible to arrest the movement of the spheres immediately on spark-over, and the reading observed depends upon how soon after spark-over they are arrested. Furthermore, a sphere gap cannot be read continuously during treatment, for it requires sparking over, the noise of which may frighten the patient, and, moreover, it necessitates turning off the current to extinguish the arc—which is quite impracticable.

When Fortescue first suggested the sphere gap as a means of measuring voltage, it was necessary to devise a means of calibrating sphere-gap voltmeters. The instrument employed—in fact, devised—for this was a precision air condenser, having its discharge measured by a galvanometer or a milliammeter, the latter being calibrated directly with crest kilovolts. Utilizing this device, we have a direct-reading crest kilovoltmeter which may be read at all times without disturbing the line conditions, and which will be independent of the line-charging current as well as of personal error due to manipulation of the apparatus.

Accordingly the manufacturers of the precision X-ray outfit with which we are engaged have developed this air condenser in a form suitable for use on the instrument as a voltmeter. A sphere gap is included as a limit gap for the machine, and further as a means for checking one crest measurement against the other if desired. Thus we have finally a constant form of rectifier which may be depended upon, a direct-reading crest voltmeter, and a precision milliammeter which insures the best accuracy possible. The whole apparatus ought by all means to put X-ray practice upon a basis of precision far beyond anything which has yet been approached in this important field.



Left: The control-stand top, emphasizing the complete insulation and the absence of live switches. *Right:* The completely assembled machine; the rectifying switch, shown above, is inside the cabinet

The external aspects of precision X-ray apparatus now at the disposal of the practitioner

Adrenalin, the Drug of the Hour

WITHIN the past few months the daily papers have been publishing news items with reference to the drug adrenalin and its remarkable life-restoring properties. Adrenalin has been hailed as the raiser of the dead. It has been endowed with most mysterious and wonderful properties. In fact, the publicity has been so strong and so widely distributed that people today must think of this "new" drug as a sort of preternatural substance, perhaps something like the famed alchemists' philosopher's stone or elixir of life.

The truth of the matter is first that adrenalin is not the new drug that people generally believe it to be. Its prominence in the day's news is due to the fact that certain physicians have lately experienced considerable success with its use in revivifying the dead, especially in bringing to life babies that were apparently born dead. But the properties of adrenalin have been known for at least 50 years and applied for at least 25.

Adrenalin was first discovered in the suprarenal glands by the French chemist and physiologist Vulpian in 1856. The suprarenal gland is a ductless gland whose exact function in the human and animal body has only been partly understood within the past few years. It secretes a substance known as adrenalin, epinephrine or suprarenine, which possesses most fascinating properties. It is a great energizer or stimulant, serving to contract the arteries and increase the blood pressure. For example if the brain is informed of some great danger threatening the body, or if it registers great fear, the impulse is transferred by means of the wonderfully swift and sure carrier nerves to the suprarenal glands and they are called upon to discharge their substance into the blood current to energize and stimulate the muscles into powerful action. Anger also results in activation of these glands and this is why the doctors tell us that anger is bad for a person with high blood pressure, for anger serves to accelerate the secretion of adrenalin which has the power of further increasing the blood pressure. This also explains the extraordinary strength of the insane.

Adrenalin was first prepared from the suprarenal glands of animals, such as bullocks and sheep, and the fact that it will increase the blood pressure was first observed in 1894. It was not, however, until 1900 that the distinguished Japanese physician and chemist, who recently died in New York City, Dr. Jokichi Takamine, succeeded in isolating the active principle of the suprarenal glands. This feat made it possible to study the physiological effects of the substance, and its real clinical history starts with Dr. Takamine's preparation of the crystalline substance adrenalin. These crystals are white and dissolve with difficulty in water. Adrenalin solution has a bitter taste and is slightly alkaline. It is found in three chemical forms, and it is important that it be manufactured in the proper form, as not all have the same physiological activity.

At the present time there are two methods of preparing adrenalin. The drug is extracted from the suprarenal glands of sheep or oxen, or else it is manufactured synthetically from catechol which is itself a synthetic product used as an antiseptic and in photography. In the extraction process the glands are properly disintegrated with water, containing a little acetic acid or muriatic acid and an extract is obtained. The extract is concentrated by evaporating off the water. Then alcohol is added to precipitate the impurities, the solution is filtered, evaporated further in a vacuum apparatus and treated with ammonia. In a few hours the adrenalin crystallizes out and may be purified by recrystallization from ammonia. About 125 grams of adrenalin are obtained from 112 kilograms of the fresh tissue. The synthetical process is quite complicated and need not concern us here, but it was due to the interest exhibited in the manufacture of this drug by chemical processes that its uses were investigated further and its application in what is known as "bloodless surgery" was developed.

The most recent use for adrenalin, wherein it is injected into the muscles of the heart, is perhaps the most startling of all the wonderful applications of this marvelous drug. It is claimed that the dead heart, especially in the case of the new born baby, is so stimulated by the drug that it commences beating again. The heart is a powerful organ, perhaps the strongest muscle in the entire body, for it must work incessantly and must be able to respond at times to the most severe demands. It is built very strongly and it can endure rough surgical usage even beyond what may be expected of it. Nevertheless, it cannot be operated upon as freely as the other organs of the body, for there must not be any suspension of its functions. The use of adrenalin renders important aid not only in heart operations but in operating on adjacent organs. In such cases the heart has been accustomed to be artificially stimulated by the surgeon who actually grasps it in his hand and squeezes it so as to produce a flow of blood through the body.

Adrenalin is also of great help in operating on the eye, the nose and throat, where it is desirable to avoid excessive flow of blood. An injection of adrenalin serves to drive the blood away from these parts, for it contracts the blood vessels and prevents a profuse flow. It also possesses the properties of an anesthetic, especially useful in operations on the eye.

Adrenalin is a wonderful drug. There is no question about that, but it must not be supposed that it is a cure-all and save-all for everything. There is no such thing as a universal therapeutic agent. Then again, adrenalin is not a universal "raiser of the dead." It is only in exceptional cases and under very special circumstances that adrenalin has actually caused a dead heart to beat again. The medical scientists are well aware of its properties, and use it in many ways for alleviating diseased conditions of the organs. That some of them, more courageous than the rest, have now and then applied it in extraordinary ways and have produced really remarkable results with it only serves to emphasize that with a drug of this character no one is entirely familiar with all the effects that can be produced. Careful experimentation and trial may reveal still more wonderful uses for this strange substance.

Leather Produced From Degreased Hog and Sheep Skins

THE leather section of the Bureau of Standards has recently completed investigational work on the quality of leather produced from degreased hog and sheep skins. In general the results show that the degreasing process is very efficient, practically all of the grease being removed without apparent damage to the elements needed for making leather. Leather made from the degreased skins is superior to that made from the natural skins, and the time occupied in tanning is reduced with more effective results. Leather made from degreased hogskins is equal in physical properties to calf leather, while leather made from degreased sheepskins appears to have sufficient firmness and an improved appearance which makes it suitable for upper leather in some types of shoes instead of goat leather.

It is believed that by degreasing sheepskins and hogskins before tanning, leather can be produced which can be brought into general use for shoe uppers and as far as the quality of the leather is concerned, it appears logical for packers to utilize hogskins for leather purposes.

No published report is available on this work at the present time, but one will be issued as soon as possible and the notice of it will appear in the Technical News Bulletin of the Bureau.

The Life History of a Star

WHEN Dr. C. G. Abbott recently stated that, as shown by careful observations and measurements, the heat radiation from the sun to the earth had diminished from 3 to 4 per cent during the past fifteen months, this disclosure may have alarmed some timid pessimists, but it caused no serious general apprehension. Many openly scoffed at the statement and ridiculed it.

Granting that the observations upon which Dr. Abbott's statement was based were thoroughly reliable, how are they to be interpreted? Do they mean that in eight or ten years the sun's radiation will be 50 per cent less than now and we shall have to crowd around the equator to keep from freezing to death? Or, are we to consider this diminution of radiation merely as a passing phenomenon caused by certain disturbances on the sun for which science cannot account?

Scientists, knowing how carefully the observations and measurements of the sun's radiation, which were begun about 20 years ago by the late Prof. Langley and continued by Dr. Abbott, were made, are inclined to accept the figures deduced by Dr. Abbott as correct. But, being aware of the fact that the sun is subject to cyclic disturbances which periodically affect the conditions on the earth, like cycles of sun spots, etc., they do not apprehend a continued and rapid decline in the heat radiation of the sun that would make the earth uninhabitable in a few years.

At the same time, there is no longer any doubt in the minds of our scientists that the sun, following the inexorable laws which govern the evolution of stars from the cosmic elements of nebulæ and their gradual devolution into cold and lifeless stars, has progressed so far already on its devolutionary down-curve that its extinction is merely a question of time. But this need not cause any anxiety at the present time—our sun will probably continue to supply the earth with light and heat for millions of years to come. For what is a million years in the life history of the stars?

According to modern astronomical theories, the history of the origin and evolution of all stars is practically the same. Our sun also is a star, though insignificantly small compared with others and its history, so far as its main features are concerned, is typical for all other stars.

Stars are believed to originate from nebulæ by the condensation of the mass of elemental gases of which the nebulæ consist. Spectral analysis has disclosed the presence of only three gases in the nebulæ examined: hydrogen, helium and nebulium, an element unknown, as yet, on earth. Of all gases known, hydrogen and helium offer the greatest resistance to condensation by liquefaction, and nebulium is probably similar in that respect. It is more than probable that other elements could not be spectroscopically identified in any nebulæ because they could not exist in gaseous form at the temperature of stellar space, closely approaching 273 degrees Centigrade, the absolute zero. No evidence of the existence of the heavier elements in nebulæ has ever been found, but it is not impossible that they may exist in the center of the nebular mass, following the laws of gravity, while only the rarefied light gases surrounding the denser center betray their presence when made luminous by Hertzian waves passing through space. Whether this is really so, or whether the nebulæ, from which the stars are evolved, are composed in the beginning of the three gases above mentioned only, while the heavier elements are gradually evolved from them by rearrangement of the structure of the atoms under the synthetizing effect of condensation, is still an open question.

The condensation of the nebular mass causes a contraction of its volume and, as a result of the crowding together of the atoms, generates heat. During the early stages of the evolution of the star, the nebular mass, still highly rarefied, yields readily to the contracting influence of condensation. The mass shrinks rapidly, causing a correspondingly rapid increase of temperature. During the steep up-curve which marks the evolution of the star the volume of its mass shrinks rapidly and its temperature rises from near absolute zero to temperatures estimated, in some cases, at 20,000, perhaps even 30,000 degrees Centigrade. The maximal temperature, which a star attains at the apex of its evolutionary curve, depends on the volume of its mass. The greater the mass, the higher will be the maximal temperature of the star at the apex of the curve. Our sun, which probably did not, even at the apex of its evolution, attain a temperature of more than 12,000 degrees Centigrade, is now far advanced on its curve of decline. It has become a dwarf among stars, with a temperature estimated at 5520 degrees Centigrade. How insignificantly small our sun is, compared with other stars, becomes evident from the fact that, for example, the diameter of Betelgeuse is approximately 230 times that of Antares more than 400 times, greater than that of the sun.

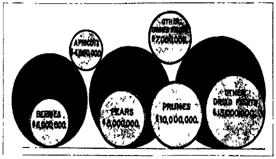
That our sun is approaching its final extinction is beyond reasonable doubt, for its mass has reached a high degree of condensation with a mean density equal to one and one-half times that of water or approximately one fourth the estimated mean density of the earth.

During the early stages of the evolution of a star its temperature rises rapidly until it reaches its maximum at the apex of the rising curve, but there is no corresponding increase in its radiation, as the rise of temperature is almost counterbalanced by the shrinkage of the radiating surface. After the apex is passed the rate of condensation diminishes and with it the temperature of the star. Slowly the volume of the declining star shrinks, its radiation becomes weaker and finally ceases altogether—the star has reached the end of its career, has become a dead star.

How long it will be until our sun reaches that point, it is impossible to foretell with any degree of certainty, but the prospect need not worry us. Its radiations shall probably continue to maintain life on our planet for millions of years to come.

Stretching the Harvest Through the Winter

A Graphical Survey of a Year's Output of America's Canning Industry



Graphic statement of the value of canned fruit, etc., put up by our commercial canneries during the year 1921

THE figures for output shown in the drawings are those for the year 1921. Complete reports for this year, however, are not available, so much of the text is based upon the 1920 census figures for the year 1919. Owing to shorter crops, 1921 was not nearly so big a year in the canning industry as 1919

ON ITS face, an industry that turns out products bulking as those in our drawings on this page bulk is worth talking about; on its face, such an industry is interesting and important, and there must be much to say about it that is worth saying and worth discussing. Before we try to say it, though, we must define exactly what this industry is.

It will be observed that we have included in its scope everything in the way of canned fruits, dried fruits and canned vegetables, and that we have excluded canned meats and fish of every description, as well as pickles, sauces, etc. The division of our preserved foods industries into two general groups along the line suggested by this inclusion and exclusion is obvious enough, and at first blush might seem simple. But the inconvenient fact is, there is much overlapping. Numerous establishments that put out canned fruits put out also pickles and similar articles. Particularly in the matter of canned soups is there a large ambiguity, for soup is a packing-house product, and at the same time a product of the vegetable cannery. Uncle Sam in his census splits the soupmakers along exactly this line, including the soups put up by the meat packers in the product of the packing industry, and those put up by other factories in that of the canning industry. We follow his lead, and this explanation constitutes sufficient definition of just what is included in the industry of fruit and vegetable canning and preserving which we display graphically on this page.

The goods which figure in our pictorial statement are not all packed in the same way. Some of them come in cases containing 24 cans of 20 ounces each, some 24 cans of 30 ounces, some 24 cans of 34 ounces, and some are packed with 48 ten-ounce cans in a case. To reduce all this to a common denominator, we have shown all the products in pounds first, and then in dollars. The pictures answer satisfactorily the questions "How much?" and "Of what value?" which are the first to occur to us in connection with a manufacturing industry.

The various cans, crates, etc., have been faithfully worked out to scale by our artist; every one of them is of the correct size necessary to contain the poundage which it is represented to contain. That our annual consumption of canned fruits and vegetables is of a volume dwarfing the Woolworth Building may surprise us, but it is true.

The humble bean constitutes the largest single item as regards mere quantity, with the raisin—unexpectedly to most of our readers, we imagine—a very respectable second. In point of value the dried grape reverses the order, and when we call it by that name and reflect upon California's vanished wine industry and the necessity of doing something with her vineyards, we need no longer wonder at its place near the head of the list.

Most interesting is a geographical survey of the canning industry, with the view of noting which States produce the bulk of the various commodities. Of the beans, Indiana cans about five times as much as the second State, referring to the baked specimen, while New York has a long lead in putting up string beans, and New Jersey accounts for more than a third of all the limas that go into cans. Wisconsin leads in beets, with New York a good second and "no third." In canning corn three States run neck and neck, Iowa, Maryland and Illinois all putting up over two million cases, while Maine and Ohio distance the other States with about a million and a half cases each. The case of corn, by the way, holds 30 pounds. Not unrelated to the canning of corn is that of hominy, in which Indiana has about two-thirds of the total production. Wisconsin is the only State worth mentioning in connection with peas, accounting for more than half of the nine million cases. Indiana leads in canning pumpkins, Maine in squash. California is responsible for 99 per cent of our canned asparagus. Sixty per cent of the canned sweet potatoes are about equally distributed between Maryland, Mississippi and Virginia, with the other States nowhere individually. California and Maryland do practically all the spinach, and the habit of putting corn and beans in cans together and calling the result succotash, prevails in New York to such an extent that it takes the next three States combined to equal the output of the Empire commonwealth. Of the tomatoes, California has four times and Maryland three and one-half times as big an output as Virginia, the third State.

The canning of apples is more distributed than that of any other commodity, New York leading with less than half a million 51-pound cases, while eight other States have more than a hundred thousand cases each. Oregon and Washington can about half the blackberries and Maine about two-thirds of the blueberries—call them huckleberries at your peril! California does about half of the cherries, Colorado and Michigan more than half of the gooseberries. Oregon and Washington monopolize the loganberries, and Maryland the pineapples. The three Pacific Coast States account between them for practically all the prunes, while the putting up of raspberries is mainly confined to Michigan, New York and Washington. Strawberries are fairly well distributed; four States do each more than 10 per cent of the nation's total, and five others have more than 5 per cent. Michigan and Maryland are the leaders. California comes strong in the balance of the list, with half of the pears, two-thirds of the plums, seven-eighths of the peaches, and all of the apricots save a vanishing minimum.

Of the dried fruits, California and New York run neck and neck as far as apples are concerned, and the rest of the tale is all California. The land of the Native Son dries all the raisins that are dried in the United States, and does not fall far below this standard in the case of the prune, the peach and the apricot.

In most instances these figures show that the canning industry depends upon the growers; peaches are canned and raisins dried, corn and beans put up for the winter, in the States where they are grown. The nearest thing to an exception to this principle which the list shows is the prominence of Maryland throughout. This prominence becomes even more pronounced when we line the States up according to the total value of their canned goods. California is the first, without competition, having an annual output of 220 million dollars. New York, with 54 million, has a long lead in second place. Maryland, New Jersey and Pennsylvania are practically tied for third, with 30 millions each. A curious phenomenon is seen when we cast our eyes down near the bottom of the list and find Virginia, with $7,500,000 worth of product and 408 individual establishments—more than California itself, and more than any other State save New York. Kentucky, with only 28 establishments, has half again as much output. Virginia, apparently, is the home of the one-man cannery. In fact, her 408 establishments averaged for the year but 21.3 workers—four per plant, against an average of about 50 workers per plant in California. The designation "one-man cannery" must apply literally to a large number of Virginia's establishments. The effort to find out what it is that Virginia cans on this piffling basis fails in the face of the fact that under almost every commodity her total output is so small as to relegate her to the group of "all other States." Sweet potatoes make up about 10 per cent of her total, and that is the only item of any consequence.

We have just employed the term "average" in connection with the payroll of the canners. This is quite necessary, because of the seasonal character of the industry. It reaches its peak in September, and its low point in March. In 1919, the last year for which complete figures are available, there were 35,602 persons employed in March and 108,047 in September, while for the entire year the average number of hands was 80,923.

Another interesting item is the percentage of female workers. Taking the average number of female hands for the year against the average number of both sexes for the year, Virginia shows the highest percentage of female workers—59.8 per cent. In most cases these women are doubtless members of the proprietor's family. Of the States where canning is on a large commercial basis, Maryland shows 58.7 per cent of the workers to be females, and California 50.8 per cent. For the entire country, the women workers constituted 48.7 per cent of the total.

In line with the seasonal character of the employment in the cannery come long hours during the months when the plant is in operation. About 61 per cent of the workers put in a working week of 54 hours or more, about 48 per cent one of more than 54 hours, and no less than 30 per cent worked 60 hours or more per week, when they worked at all.

Every year we eat enough canned and dried goods, as itemized above, to dwarf the Woolworth Building. The cans and cases are drawn to scale, the size they would have to be to hold the poundage which they represent

A Trade that Is Passing

A PECULIAR trade practiced in some parts of Italy is that of the peddler of leeches. So greatly have these little animals lost caste among our own medical practitioners that probably most Americans of the younger generation hardly even know what they are. Their name implies that they are physicians, but they are decidedly of the old school. They were in their glory in the days when blood-letting was the favorite remedy for almost any malady whatever, and when the barber was the surgeon as well.

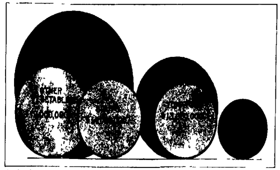
This little aquatic worm has a sucker at each end of his body, which he uses in place of feet for traveling on land. He attaches first one and then the other to the surface over which he is progressing, alternately lengthening and shortening his body as he moves. With the anterior sucker he also earns his livelihood. In his infancy he is perfectly satisfied with sucking the blood of such low orders of animal life as he finds in his native pool. But he soon gets a taste for the blood of mammals and finds he prefers it to any other. He has three very sharp serrated teeth, like semicircular saws, arranged in a triangle. With these he makes a tiny wound in the skin and sucks himself full of blood if allowed to do so. In order that the blood may flow freely he injects into the wound a chemical of his own manufacture which prevents coagulation, and which incidentally causes a considerable further loss of blood after he has finished his repast unless some measures are taken to prevent it. When used surgically, the leech may be placed inside a small glass tube to insure his taking his lunch from the exact spot desired. It is said that he never carries any infection unless he takes it from a former patient, for which reason it is customary not to use the same one twice. His victim may think him a glutton. But his tastes are really frugal, since one good meal will last him for several months. He is free, too, from many other cares that afflict humanity. Thus the rising death rate from diseases of the heart does not trouble him, for he has no heart. The question of woman's rights does not fret him neither, for each individual is of both sexes.

In Tuscany and some other parts of Italy the mignattaro or peripatetic vendor of these beasts is a fairly regular visitor, making his rounds once or twice a month, usually peddling also one or more varieties of medicine guaranteed to cure all the ills of man or beast, for nowadays there are some who seem to prefer internal medication to parting with their blood.

But before he sells his wares he has to catch them, and that, on the face of it, does not seem a very pleasant part of his job, although certainly the excitement of the chase is not wholly lacking. Going to one of the pools in which the leeches are known to abound he removes all his lower garments and pulls on a pair of drawers thick enough to resist the attacks of his prey. He then wades in, beats the surface of the pool with a staff, and stirs the water vigorously with one leg. The simple-minded leeches, thinking themselves the hunters instead of the hunted, attach themselves to his drawers in the vain expectation of securing a feast. But the mignattaro deftly removes them first from one leg and then from the other and thrusts them into a small bag.

This hunt is carried on throughout the year with the exception of the dry summer months, which are not favorable for the purpose. But the prudent mignattaro will have accumulated a surplus in the spring, which he can sell later. Once caught, the leeches need little attention save a daily change of water, owing to their ability to live a long time without food. The mignattaro sells his wares at retail to private individuals and at wholesale to pharmacists and to barbers, for some of the latter, no longer letting blood with their razors, both sell and apply leeches. Indeed, leeches may occasionally be found for sale by Italian barbers in this country. Formerly the mignattaro would sell his leeches for as a little as a cent apiece, or even three for two cents. But now he gets several times as much. When the pharmacist sells them he in turn makes a profit of several hundred per cent, but doubtless needs to do so, since the ungrateful animals often die on his hands.

Many eminent physicians in Italy prescribe leeches for their patients, and the use of them is very general, especially in the country. During the last epidemic of influenza they were particularly in vogue. And a single mignattaro is said to have made a snug little fortune at that time, selling thousands of the leeches at a franc apiece. But the influenza does not come every year, and the ordinary profits are not enough to attract the younger generation of Italians. It seems, therefore, as if a few more years might find the trade of mignattaro quite extinct. And what will the poor leeches do then?



Further items in the dollars and cents comparison. The areas of the circles are proportional to the amounts which they represent

Copper Qualities

COPPER sheet, according to a circular on copper by the Bureau of Standards, is made from cast cakes three or four inches in thickness by hot or cold rolling. For tanks, etc., these cakes are hot rolled nearly to size, pickled in acid and then cold rolled down to the final size. But for the smaller gages of sheet copper cold rolling is resorted to, the furnace cake being first hot rolled to about one-quarter inch, annealed, pickled and rolled down to size cold with intermediate annealing.

Seamless tubes are made by casting a hollow cylindrical billet and drawing down cold over a mandrel, or by piercing a solid cylindrical billet. This is done at a temperature of 850 degrees Centigrade. The pierced tube is quenched in water and further reduced by cold drawing over a mandrel.

In welding copper by the oxyacetylene process a larger size blowpipe is required than for iron, but with a flame of lower temperature. Copper cannot be cut by the oxyacetylene flame, however. In arc welding two or three times the power is required than for iron.

Copper may be hardened by mechanically working it or by adding some alloying element. The "tempering" of copper by primitive peoples, which is erroneously held by many to have been a lost art, is brought about by hammering. Copper dissolves about 11 per cent of tin, and up to this limit is hardened by its addition.

The corrosion of copper consists in the formation of a thin protecting layer of oxide or green basic carbonate, but in marine atmosphere an oxychloride is formed. Some small pits that may form are attributed to local electrolytic action caused by the presence near the pit of some substance electropositive to the copper. This may possibly be copper oxide or some of the basic oxidation products of copper. Hard copper is more corrodible than soft, the former corroding up to five times as fast as the latter.

Our Reserves of Energy

The Heat and Power of the Future, Seen from the Brighter Side

By Leo G. Hall

> *EVERY little while some well-intentioned alarmist tells us that our fuel resources are within twenty or thirty years of exhaustion. He then draws a lurid word picture of cold homes and stilled wheels of industry. Consequently there is a widespread popular belief that the next twenty years, or fifty at the outside, will see us in the cold unless we take immediate strenuous measures to utilize other large supplies of energy.*
>
> *Now this is mostly nonsense. Without repeating statistics already published at length, Mr. Hall calls attention to some general considerations showing that we will never exhaust our available supplies of coal or even suffer from a serious fuel famine, and that even if we knew we should have to face definite exhaustion of fuel resources five years from today, we could prepare for the jump, in the present state of development of the arts involved, with no serious suffering, and with much less flurry than we underwent during the great war.*—THE EDITOR.

ACCORDING to authentic recent information, the world's known anthracite resources are about 30 per cent exhausted. The known bituminous resources are about 7 per cent exhausted. In addition to this there is a supply of lignite as yet practically untapped which is greater than the bituminous supply. It is about a hundred years since coal supplies began to be tapped to any great extent. In that period about a sixth of the known coal supply has been used. How much unknown coal is stored away no one knows. But there is certainly a considerable amount in the unsurveyed reaches of Siberia, China and Africa.

Additional to all this there are great peat bogs on all of the continents which with the improved methods of unwatering now being put into use in Germany will form still another fuel reserve. I do not mention oil and natural gas, for they have never formed an important part of our energy requirements, and they are already apparently within measurable distance of exhaustion.

We are pyramiding our fuel demands year by year. *Every year sees more used than the year before.* If that process keeps up indefinitely, it is, of course, only a matter of time before supplies are exhausted. But it will take much more rapid pyramiding than has occurred in the past to exhaust the coal, let alone the lignite and peat, within the life time of any person now living.

Economic factors will, however, gradually enter the field and stop the use of coal for fuel long before the supply is exhausted. The coal we have mined to date has been that within easiest reach and which can be mined at lowest cost. As these easily mined fields are exhausted, the cost of coal will go up. This rise in price may be retarded somewhat by improved methods of production but it will none the less go on. Gradually the cost of power from coal will exceed the cost of power from other sources not hitherto developed because not hitherto considered economically worth while. And as fast as these other sources of energy become more worth while than coal power they will supplant coal power. The cost of coal power does not need to go very much higher before very large blocks of this other energy are thrown into competition with it. It will interest us here to see what other large supplies of power are available.

The first and most obvious of these is, of course the power of rivers and waterfalls. Engler, I believe has estimated that the energy which might be taken *economically* from these waterfalls is sufficient to replace 60 per cent of the world's present coal demands. Note that word *economically*. Recent developments of efficient low head turbines have already brought a much larger portion of the world's watercourses within the economic fold and Engler's estimate is already out of date and too low. A large part of the world's potential water power is of the low head type. And Engler's figure should be increased by about half to include this.

With a comparatively small increase in fuel price, other developments not included in Engler's estimate by reason of high cost will become economic competitors of coal and will be developed. Developments now carried to only a quarter or a third of potentialities will be increased to full capacity when the price of power warrants it. All in all, with the price of fuel but little higher, there will be power economically available from rivers and watercourses not far, if at all, short of the total fuel power requirements of today.

While it has been objected that much of this power is too far out of the way for use, it is also one of the laws of economics that "if the mountain won't come to Mohammed, Mohammed will go to the mountain." But no wholesale changes of seat of industry would be necessary. High tension transmission of current for a thousand miles is within the range of present technique. Its commercial transmission over several hundred miles has been an accomplished fact for many years.

In addition to the potential power of rivers and waterfalls, there is a vast store of perpetual energy in the tides. Recent developments of efficient low-head turbines have rendered the development of tidal power economic, and several very large tidal-power plants are under construction in Europe today. The high tides of Nova Scotia are also being utilized in a considerable development in progress.

It is hard to say how much power is available by this means but it is safe to say that a majority of the world's tidal estuaries and narrow mouthed bays are capable of development so as to furnish their thousands of horsepower each. Probably power can be developed from tides in excess of what can be developed from rivers and waterfalls. And a large part of this power could compete in the open market with coal even at present prices.

It is at any rate certain that the above two sources of power alone are more than sufficient if completely developed, to replace the world's entire coal consumption and meet growing demands for many years to come. But we have not begun to exhaust available sources of energy.

How about fuel for heating and the replacement of liquid fuel for internal combustion engines? The answer to this question lies in sun power. I do not refer to the cumbersome machines which we are wont to associate with sun power, but to nature's process of storing up sun heat in the sugars, starches and cellulose of plants, and the utilization of it by converting these substances into alcohol which can be used for fuel. Alcohol can be produced today at a cost, power unit for power unit, about a third of the cost of gasoline. It can be used in any gas engine with a small adjustment of the carburetor.

Germany today produces her millions of gallons annually of fuel alcohol, almost entirely out of waste products. We in this country are accustomed to associate alcohol with fancy prices, because government restriction has made the cost high. But we are the only large nation that is so restricted, and the time will come when we shall have to put ourselves on a par with the rest of the world and permit unrestricted manufacture of alcohol. Already our industries have suffered much by alcohol restrictions, even before the recent hysterical prohibition legislation.

The beauty of alcohol as a cheap fuel is that it can be made from garbage, sawmill waste, the rank growths of marshes, weeds, cacti, sage, and from other organic wastes, which are now heavy liabilities. Within the lives of the present generation the world will be harvesting its fuel crops as regularly as it now harvests food crops, and alcohol will be produced far in excess of present gasoline manufacture. Wherever the sun shines there is potential alcohol.

There are still other sources of power which will be put to use on a large scale as economic considerations dictate. We have most of us read of the solar heat machines which are used in Egypt to produce power for pumping purposes. These are economically worth while in Egypt because coal is there scarce and expensive. They will become worth while and be put to use on a large scale elsewhere as fuel becomes more expensive. Recent developments in the art have also brought the cost of solar power equipment down to the point where it is very nearly an economic proposition in parts of the United States today. The near future will see commercial sun power plants in operation here. And undoubtedly we will most of us live to see giant plants in operation on the cloudless deserts of the southwest, transmitting their power both to the coast and to the great cities of central United States over high tension lines at from one to two million volts, or perhaps by wireless.

The *average* intensity of radiation received by the earth's surface in Arizona and Nevada during daylight hours for the entire year amounts to about one-third horsepower per square yard of surface, or a million horsepower per square mile. Probably not more than 70 per cent of that can be practically realized. But even at that, a single Arizona County could produce power enough to supply the entire power requirements of the United States. I believe that our present demands are about 15,000,000 horsepower. Probably the consumption of the whole world is not in excess of 100,000,000 horsepower. Yet there is solar energy going to waste on the deserts of the world sufficient to supply several billion horsepower continuously, with the proper storage and transmission facilities. It could be done today. It would be done today, if the demand were sufficient.

There is scarcely a district in the world that is not within transmission distance of large supplies of tidal power, river power or solar power. And there are still other large available supplies of energy.

During recent fuel shortages several successful wind power plants were built and operated. Recent advances in the art have made it possible to do away with the old cumbersome stiff windmill and substitute a sort of wind turbine which is light and strong, and will operate efficiently under a much greater range of wind velocities. Improvements in generating apparatus make it possible to generate and store a uniform current from an exceedingly variable source of power. The time may come when every household has its wind plant on the roof, with storage batteries in the basement, to furnish power for lighting, heating and cooking. It is economically practicable even now, if people only knew it. When there is sufficient economic pressure, firms will go into the manufacture of apparatus for that purpose, and the thing will be done. At any rate, here we have another large available supply of energy.

Then we have the internal heat of the earth itself to draw on. There are many hot water springs, steam vents and hot gas vents in different parts of the world. Exceedingly high temperatures are reached in some places by simply drilling a few thousand feet. In Italy a natural steam vent has been improved by drilling and then harnessed for practical use to furnish 16,000 horsepower continuously. In Montana there is a nursery which derives part of its heat from natural hot water springs. Most of the mountainous or volcanic regions of the earth could probably be made to furnish continuous energy in considerable amounts by tapping them.

I have pointed out above, sources of power which could be developed today, without any further advances in the art, if conditions were such as to warrant their development wholesale. These sources would together certainly supply the power energy demands of our globe many times over.

I have not yet mentioned promising possibilities which are not yet developed—vast stores of power which we know exist, though we have not yet found the key which will unlock them. There is the power locked up within the structure of the atom, which radioactivity has shown us. This is a store so great as to stagger the imagination. Any year, almost any month, may easily announce the "Open Sesame" to this store house.

Experimental work is going forward with relation to making artificial fuel. That is, finding an endothermic catalysed low-temperature reaction which will take place slowly under the sun's heat during summer months and which can be reversed rapidly at will in the winter months with the evolution of the stored heat. Such a discovery would render the cumbersome and expensive solar machines unnecessary. Some progress has been made along this line.

(Continued on page 215)

An Automatic Exposure-Meter

By Dr. Alfred Gradenwitz

CORRECT exposure is, of course, an essential condition of any satisfactory photographic work. In fact, while there is some latitude in this respect and while mistakes in gaging exposures can, to some extent, be made up for by skillful developing, a large percentage of both amateur and professional work is spoiled by improper exposure The main difficulty in this connection is due to confusion, the brightness of some given portion of the objects or scenery to be photographed being appreciated, rather than that of the entire picture as a whole.

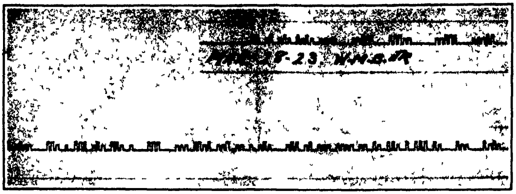
Thus suppose the water-scape herewith is to be photographed, the circular frame being, to begin with, left out of account. The time of exposure should be so chosen that the darkest portion of the picture, the fringe of the forest in the background, is reproduced with some detail On the other hand, exposure should not be prolonged sufficiently for the brightest portions of the picture, the sails, to be over-exposed so that the more delicate shading would be subdued in a uniform black on the plate and a correspondingly uniform white on the positive print Generalizing the time of exposure should, in any case be so chosen as to keep the exposure corresponding to the brightest portion of the picture below a given maximum and the exposure corresponding to the darkest portion above a given minimum

This is the fundamental principle underlying the construction of Dr Schlichter's new actinometer In fact when pointing this instrument, which in outward appearance resembles a small telescope, at the scenery to be photographed the picture is seen through a blue filter surrounded by three checking sectors, as in our example—a bright a medium and a dark one The fourth sector corresponds to complete darkness and is not used for checking purposes.

The checking sectors are so graded with regard to one another as to correspond exactly in brightness with respective degrees of illumination at which under-exposure ends, at which normal exposure is at its median point, and at which over-exposure begins. Accordingly in a striking manner, they delimit the range of correct exposure The photometric balancing of the brightness of the picture with the checking sectors is effected by turning the milled ring *a*, and through it the iris stop, so as to have no portion of the picture remain brighter than the brightest, and no portion darker than the darkest of the three checking sectors. In the sample picture here used, which is rather rich in contrasts, the sails should be of about the same brightness as the brightest, and the fringe of the forest about as dark as the darkest checking sector, while the water sheet receives the average tint corresponding to the medium-brightness sector The adjustment thus obtained is read from the scale *b* This balancing operation reduces the picture as a whole to a single brightness.

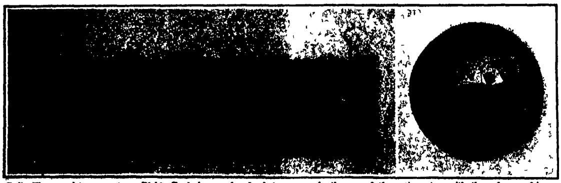
Now, the light serving to illuminate the checking sectors is nothing else but the daylight in the space in front of the instrument. Its absolute brightness can be ascertained by gaging the blackening time of a strip of photometer paper visible at *c* in the rear part of the instrument. The scale-reading on *b* and this blackening time are next adjusted to one another the ring *d* being turned until the two figures appear beside one another on the left hand scale The proper time of exposure is then read from the same ring (on the right hand scale) at the point that falls opposite the number corresponding to the objective stop used in the camera

The instrument has the shape of a small telescope and is mostly made of light metal, thus weighing only about 130 grams Its main distinctive feature, as compared with other actinometers is the elimination of the sensitiveness of the eyes and the direct balancing of the brightness of the picture with the blackening time of the photometer paper In fact the instrument constitutes an actual photometer of known accuracy and, accordingly eliminates all personal equation



A specimen of the transmission of the newly proposed telegraph code

The transmitter that would make the new alphabet applicable alike to cable, land lines and radio



Left: The complete apparatus. *Right:* Typical example of what one sees in the eye of the actinometer, with the reference fringes of varied shading

The automatic exposure meter and the way it works

Doing Away with Dots and Dashes

By S. R. Winters

SWEEPING revision of the method of transmitting the Morse alphabet with respect to radio telegraphy, land line telegraphy, and submarine cabling, was recently outlined by Major General George O Squier Chief of the Signal Corps of the War Department, in a lecture before the National Academy of Sciences. The modified system of signalling would reduce the varying time-periods of the telegraphic dots, dashes and spaces to a common duration Dots, dashes and spaces would be distinguished not by duration but by variations in the intensity of the signals

The different intensities in a dot dash, or space, under the proposed new system of signalling, would be effected by the use of alternating electric current Each half cycle or arbitrary multiple of a half circle would represent one of the three individual sending elements, depending upon the intensity These different intensities are, of course accomplished at the transmitter This improved method of transmission has already been subjected to experimental application in submarine cables and a means provided for interpreting the alternating current into understandable signals Radically differing from the present system of the sending of the International Morse code, in the system being described no two adjacent signals are of the same sign, since each semi-cycle is employed to obtain signalling affording a dot dash or space

The Code Section of the Signal Corps of the War Department in applying this novel form of telegraphic alphabet to submarine cabling discovered that "Other things being equal, the variations in intensities for each of the three elemental signals are reduced to the minimum on the theory that the minimum possible change of the fundamental wave should be made An alternating current in the steady state which amounts to a series of the present cable letters "s" or "n" strung together without space can attain a speed in any form of telegraphy many times greater than any practical system for the reason that a single sine wave is transmitted through any form of electrical circuit without distortion of any kind and, in fact is the only type of wave that is so transmitted"

In striking contrast is this contemplated system of telegraphic signalling to the method now in force The powerful radio-telegraph stations, for instance do not attempt to correlate the actual sending of the dots, dashes, and spaces with the phase or supply of electric current entering the transmitting antenna The telegraph key is opened or closed without regard for the phase of the antenna current Thus, in the transmission of one message a relatively large supply of electric energy in the antenna may be interrupted at widely varying values—from zero to maximum, positive or negative Many of the existing disturbances in the ether, which mar the audible reception of radio telephone messages, are blamed on this. An abrupt breaking or introduction of high impedances in an electric circuit, using alternating current, produces transient phenomena ultimately resulting in the flooding of the ether with "mush or harmonics Coupled with this condition is the irregular procedure of operating powerful radio-telegraph stations

(*Continued on page 216*)

Relics of the 1840's

An Interesting Chapter from the Early History of the Telegraph

By A A: Hopkins

The point in Fort Washington Park from which S. F. B. Morse strung his experimental wire across the Hudson

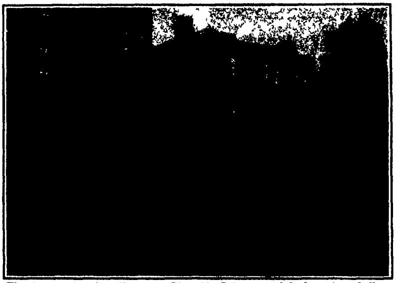
As WE walk along Riverside Drive in the neighborhood of 158th Street, New York's beautiful river drive we look down on what seems to a stranger to be a ram shackle old mansion swept into a circle of retaining wall by some quirk of the tide Not so to those who live near by for they know that Audubon spent his last years in the house, and that here Morse carried on many of his experiments in long distance telegraph transmission

In 1842 John James Audubon, then 62 years old, purchased a tract of 24 acres far out of the city and on the Hudson's bluff bank Audubon thought that at last he had an idyllic spot to pass the remainder of his days amid orchards, a babbling brook, and a tiny waterfall So he named it "Minnie's Land," "Minnie" being the Scotch word for mother All went well for a time but the railway clamored for an entrance into the city, and why not take the water level and travel along the river? Soon the beautiful sandy beach was cut through ruthlessly and Audubon had to build a piazza on the other side of his house to blot out the new symbol of civilization Of course Audubon was advancing in years, but he still painted in a room on the north side of the house where the bay window is now, and here some of his exquisite pictures of birds and animals were executed

To this house came as a welcome guest another painter of no mean order, although a portrait painter His name was Morse, and he was dabbling in electrical experiments The laundry on the south side of the house, on the cellar level, was given him for a laboratory, and even within the memory of men now living have pieces of wire been picked up from this cradle of the telegraph Dates are strangely absent in the biographies, but it is probable that he had already made his basic invention before coming to see Audubon, at any rate this dingy laundry now entirely boarded up is an important link in the history of long distance transmission Mr Reginald Pelham Bolton, a historian of New York, whose garden leads into the contracted Audubon park, took the writer on a most interesting excursion to find where Morse crossed the Hudson with his aerial wires. A walk of about a mile led into neglected Fort Washington Park, and after crossing over the railroad by an open cut, which must have been a triumph of engineering in the early days, we began a search for the rock where Morse stepped his mast. At last it was found, and after the leaves and earth were dug out we were able to photograph it and also the eye-bolts for the guy-ropes some distance away The mast must have been of great height as the hole in the rock is over two feet in diameter, and while not deep served to hold the mast thoroughly firm and upright, with the aid of the guy ropes An early work on the electric telegraph describes some of the difficulties encountered as follows

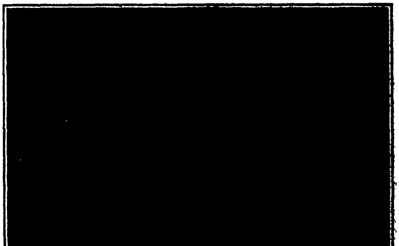
"For a long time the dispatches were carried over the river by messengers in boats, but finally, the line was submerged by Mr Ezra Cornell in leaden pipes, the wire being covered with cotton, and insulated with India rubber This was November 20, 1845. There were two cables thus formed, and they worked very well for several months, until they were carried away by the ice in 1846. They crossed the Hudson at Fort Lee, some 12 miles above New York City When these cables were broken, high masts were erected and wire upon them was stretched across the river Men were in attendance all the time to repair the wire when broken by vessels. It was the custom to let the wires down into the water for vessels to pass and then to draw them up again This was practicable in tide water, but not so with the inland rivers. The Hudson river at the place of crossing was 2700 feet wide These masts were constructed under the direction of Mr. Henry J Rogers, the energetic superintendent of the telegraph In 1847 another effort was made to cross the Hudson with a cable, and to that end a copper wire, covered with gutta-percha by Mr S T Armstrong, was purchased and submerged by Messrs. T M Clark and J W Nortons for the Magnetic Telegraph Company The cable was placed across the river at the foot of Cortlandt Street It worked for just one day, and was then torn away by an anchor

"On the lines constructed by Mr Henry O'Rielly throughout the great west, many rivers had to be crossed, over which the wire was stretched The widths of these streams were from 1000 to 3000 feet. The first crossing was that at Wheeling, over the Ohio river, 1800 feet, the next was that over the Ohio at Louisville The latter was one of great expense"



The famous Audubon House on Riverside Drive, now left down in a hollow far below the permanent grade, and falling to ruin In this house Morse did much of his work upon the telegraph

So the railway and the telegraph were early placed in close relationship, Morse's mast overlooked a gigantic engineering work, for the time. This, the only railway into New York proper, was for a long time along the Hudson, the trains running through Eleventh Avenue to the depot at 30th Street, and here Lincoln's body was brought through the cut and past the Audubon House, and along New York's "back yard" as it were. Much of New York's freight, especially foodstuffs, still comes in by this route, and one passenger train a day in each direction ran until the efficiency brought on by the war rendered it unnecessary thus to protect the franchise. Audubon himself lies buried in the eastern section of Trinity Cemetery, a few hundred feet away The Audubon House should be preserved as a monument to a great naturalist and a great inventor, but the ravages of time will soon wipe out this very interesting landmark.



One of the bolts to which the guy ropes for the mast were secured is still to be found by one who will search for it

Something About Calories

WHEN calories are mentioned in nutrition, it is from the point of view of food fuel value. The caloric value of a diet is a factor of great importance in nutrition. Frankland (1866) was the first to determine this for various foodstuffs by oxidising them in a calorimeter He did not express the results in "calories" but rather as "heat units," which, however, had the same value Stohmann (1879) and Rubner (1883) were apparently the first to use the term calorie as it is now applied in the science of nutrition. Rubner made three outstanding contributions regarding the calorie in nutrition (1) He applied its present-day meaning to the term, (2) he determined the caloric value of protein, fat and carbohydrate, figures which are widely used in determining the energy content of a diet, (3) he drew the distinction between the absolute and physiological heat values of foods. By absolute heat value he meant the amount of heat yielded by a substance when oxidized in a bomb calorimeter; the amount of heat produced by the substance in question when burned within the animal body he regarded as its physiological heat value. These values may or may not be identical, a fact which is of fundamental importance in the science of nutrition

Calorie as a mere word explains nothing. It is a symbol for an idea, however, which, as we have seen, has undergone changes brought about by the development of several sciences. Ancient and hazy notions regarding the phenomenon of fire and combustion first contributed to this concept, placed on a firmer foundation by the clarifying influence of Lavoisier The broad generalization regarding force in nature, receiving its impression in the law of the conservation of energy, played a decisive rôle in the evolution of the idea. The history of the calorie in nutrition, therefore, is wrapped up in the history of nutrition itself and the fundamental natural sciences upon which this branch of knowledge rests.

A Flexible Clutch for Marine Diesel Engines

AMONG the new features introduced into United States submarines recently completed is a new type of flexible friction clutch. The basic principle involved is that of the application of friction between two grooved surfaces, one being the inside of a drum and the other, the moving surface, being a series of shoes moving radially from the center of rotation. The convoluted surfaces are to give increased friction in a minimum of space.

The United States submarine S-2, driven by the new clutch that engages and disengages in motion, just like an automobile clutch

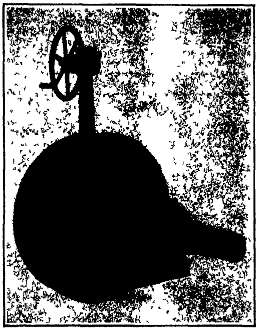
The special problem arising in submarine operation, at which the new clutch is directed, is the need for a connection that will allow flexibility in case either the motor or the engine should be subject to misalinement, following any deformation of the ship's structure from her conditions, pressure when submerged, or wear in the bearings of either of the main elements. It was also necessary to have a connection that would absorb or deaden vibrations in case the flywheel of the engine, acting in opposition to the rotating weight of the electric-motor armature, should introduce torsional vibrations in the intervening shafting, resulting in crystallization and breakage. Also there was needed a connection capable of engagement and disengagement while under way.

During the war the problem here stated was acute, but was solved only in a temporary fashion, by use of a clutch of the multiple jaw type, in which the design was held down to the simplest possible standard to facilitate manufacture. There were in this clutch forty or more jaws, to make engagement possible with only a slight amount of turning to get the jaws into alinement. The new clutch is designed to transmit normal load at about 1000 revolutions, with 50 per cent overload capacity. It was first tested in the United States submarine S-2, one shaft retaining the old multiple-jaw clutch while the new one was mounted on the other. The vessel was sent to sea under the most severe weather conditions, with orders to stay out for 48 hours, and to disengage and engage the clutch at regular intervals. This was a sort of authorization to break the clutch *if it could be broken*.

The new clutch came through this ordeal with flying colors, and it has since carried the S-2 on a voyage of 8600 miles from Portsmouth, N. H., to Hawaii—the longest straightaway trip by a submersible. The contractors, as a result of this, have been instructed by the Navy Department to equip all subsequent submarines with the new clutch.

To appreciate the importance of having, on submarines, a clutch that shall act substantially as does the clutch on an automobile, it must be noted that when coming to the surface from a submerged run the vessel, if equipped with a plain jaw clutch, must apply the brake to the propeller shaft in order to bring the jaws in line with each other before engagement. In the presence of an enemy this loss of time may be fatal. Vice versa, when diving, disengagement can commence before actually stopping the engine, the motor got under way in advance and engaged without stopping the propeller, again saving valuable time.

Referring to the drawing, the clutch operates in accordance with the following description. A series of shoes *B* moves radially in piston-like guides *D*, *F* and engages the grooved inner surfaces of the friction drum *A*. The drum is preferably of hard cast iron, the shoes of soft, and the shoe-carrier *B* of bronze. The guides *D*, *D* connect the shoe and shoe-carriers. The sliding sleeve *P* is connected with each shoe-carrier by means of an adjustable link *Q*, with a pin in each end, and with a helical spring *R* mounted on each link to permit of adjustment in proportion to the load to be carried. This adjustment is effected by



General view of the new clutch, showing the radially-moving shoes

dismounting the cup *F* and removing the guides *D*, *D*.

When the load is engaged, the link first moves the shoe radially outward until the friction surfaces make contact, then continuing in its motion, it compresses the spring until the proper tension is reached, in proportion to the load to be carried. The hole for the pin in the outer end of the links *Q* is elongated to allow play between the link and the shoe-carrier. This relieves the tension on the spring when the clutch is released, and allows the link to pull back the shoe when the load is withdrawn.

When the shoes wear down, the link *Q* can be adjusted by withdrawing the lower pin and unscrewing the lower link *A A*, until the desired length is obtained to compensate for the wear. The friction shoe *B*, carried by the shoe-carrier *h*, is so constructed as to permit sufficient lateral movement to allow it to center itself into the grooves of the rim. The driving member *K* and the driven member *J* are not connected to hold the center rigid, so if the steady bearing *L* by some unaccountable reason drops slightly, the flexibility of the springs will permit the clutch to run still engaged.

The counterbalance weights *B B* offset the centrifugal force of the shoe and shoe-carriers, and facilitate clutch disengagement when in motion. The worm-driven mechanism *V-CC* is used only for large powers. The worm-wheel *N* runs between babbitted surfaces in the casing *M*, and also the shifting sleeve *O*. It is not necessary to run this clutch in an oil-bath, though liberal lubrication is required in order to assure the proper overload-slipping regulation.

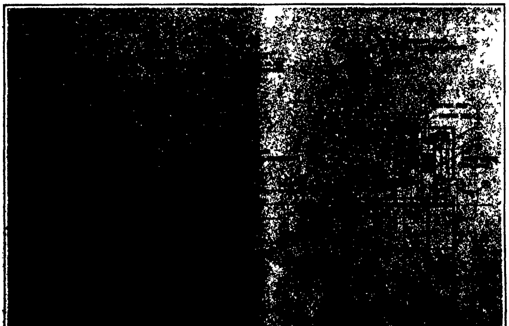


Diagram showing operation of the flexible clutch; the reference letters are explained in the text

Friendly Germs

OUT of about two thousand kinds of bacteria only about one hundred are believed to be harmful. Without the other nineteen hundred life on the earth would soon die out. We, as well as the animals whose flesh we eat, derive all of our sustenance from the vegetable world. Plants require that the soil should contain humus, and humus is brought about by the decay of other plants, which in turn is caused by bacteria, or germs. Without humus, plants establish themselves very slowly, so that if we were to kill all bacteria no more decay would take place. The soil would soon be exhausted and we should all die of starvation.

In a more ordinary way there are many bacteria which are of use to us every day. They produce vinegar. Lactic acid germs give the flavor to butter. Germs help make cheese. They help digest the food in our stomachs. And, finally, they cause juices to ferment into alcohol, even in the United States with its adverse legislation.

Harmful germs of many kinds are always in our systems, and this causes many people to worry, often unduly. The fact is, they cannot possibly be eliminated. Even if it were possible to get rid of them we should be in danger of killing with them the many good germs we must have in our bodies in order to live. The first germs our most carefully protected food meets with are ptyalin and epilepsin, which are always in the saliva. Without them we should all be chronic dyspeptics in a short time, for they attack our food in a most satisfactory part of digestion. Therefore, efforts to keep the mouth "germfree" with toothpastes would be unsafe even if they could succeed. However, when the germs are destroyed by the dentrifice a new supply is very soon brought in from the saliva glands. And through the breath millions of new germs of the harmful sort come at once. If we keep our bodies in good health however, germs will give us little trouble. It is only when they are present in abnormal quantities, or when our resistance goes down, that they menace us.

Making Wrought Iron a New Way

A Mechanically-Operated Puddling Furnace which Does Away with Much Manual Labor

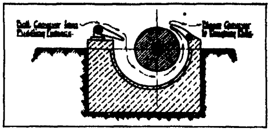
By Prof. Albert Sauveur

SO SIMPLE is the operation required for extracting a small mass of metallic iron from rich ore that the primeval man may have discovered it by means of a fire accidentally lighted upon ground where iron ore existed near the surface. Indeed the first iron furnace of which we have any record consisted in a single excavation dug on the side of a hill facing the prevailing wind with an opening at the bottom for a draft. The treatment in this crude appliance of some rich iron ore mixed with charcoal resulted in the production of a small pasty lump of iron mixed with slag, that is, of wrought iron. The simple furnaces which later displaced these rough devices were known as forges or bloomeries. A process of this kind was used for many years in the United States, the furnace employed being known as the American bloomery. The operation lasted about three hours. The iron bloom produced weighed from 300 to 400 pounds, and the charcoal consumption was about 2½ times the weight of the bloom.

Such processes are known as direct, because they yield a malleable metal in a single operation from the treatment of the ore. They remained the only method of obtaining iron until the fourteenth century, when the blast furnace came into existence. In this furnace the treatment of iron ore with a suitable fuel and with flux yields a product known as cast (pig) iron, which is not malleable. In order to convert it into a malleable metal (wrought iron or steel) it is necessary to deprive it of some of its impurities, notably of the large proportion of carbon it contains, an operation known as refining.

The refining of cast iron was first performed in a simple furnace not unlike the forges and bloomeries used at the time for the direct extraction of iron. The method was called indirect because it required two distinct operations in order to obtain a malleable metal. In these furnaces pig iron was heated in contact with charcoal and subjected to the oxidizing action of an artificial blast which caused the expulsion of the carbon and other impurities and thereby the conversion of the pig iron into wrought iron. These "fineries" remained the only methods of converting pig iron into wrought iron until the invention by Cort in 1784 of the puddling furnace. The greater economy of this new process caused the finery methods to be discarded. In the puddling process the pig iron is treated on the hearth of a reverberatory furnace, where it comes in contact only with the flame and gases resulting from the combustion of the fuel in a separate fireplace, the metal being decarburized and otherwise refined through the oxidizing action of the prevailing atmosphere and through the action of oxides of iron introduced for that purpose in the form of a furnace lining known as "fettling," and of additions to the charge of suitable mill scale. From 400 to 600 pounds of gray pig iron are generally treated in the modern single puddling furnace, the operation lasting about an hour and three-quarters and the consumption of fuel (bituminous coal) amounting to as much as about one ton of coal per ton of iron produced.

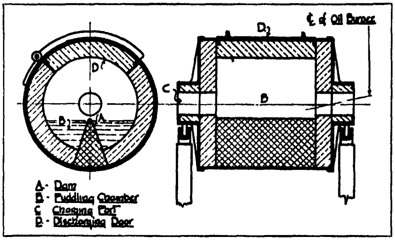
The operation of puddling is very laborious, requiring nearly constant stirring of the fluid, and, later, of the semi-fluid or pasty mass, in order to promote oxidation and toward the end of the operation, agglomeration of the metallic particles. As might be expected, early efforts were made to devise mechanical means of replacing this excessive and therefore costly manual labor. These efforts have consisted generally in the design of mechanical rabbles and of mechanical (revolving, oscillating, rocking) furnaces. None of these appliances, however, proved successful and wrought iron continued to be manufactured practically as it was in the days of Cort. These repeated failures at cheapening the cost of manufacture of wrought iron and at increasing the output of that metal led many to prophesy that eventually it would be entirely displaced by soft, mild or low carbon steel, which in the Bessemer converter could be produced in enormous quantities and at low cost, unless some ingenious mind solved the problem.



Conversion of puddled ball to bloom, the arrows indicating the direction in which the metal travels

Many consumers and engineers continue to use or to prescribe wrought iron, however, in spite of its much greater cost, which is conclusive evidence that for many purposes it is considered superior to mild steel, and it is also obvious that if the cost of production could be reduced and the tonnage increased, wrought iron would be used much more extensively. There is little doubt but that many are waiting for this to come to pass in order to shift from the use of mild steel to that of wrought iron.

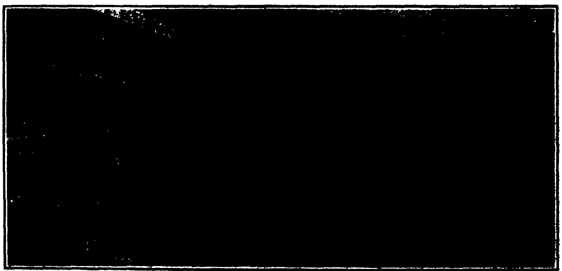
This willingness to use the more expensive wrought iron in preference to steel is due chiefly to its greater weldability, greater resistance to corrosion and greater freedom from brittleness and from binding of joints. This need of long standing for cheaper wrought iron and more of it appears to have been met. In the new process the small reverberatory puddling furnace fired by bituminous coal is replaced by a cylindrical revolving oil-fired furnace in which charges of pig iron weighing some 1000 to 1500 pounds may be treated as against charges of 400 to 600 pounds of the ordinary single puddling furnaces. The pig iron previously melted in cupola furnaces is introduced into the furnace and at the proper stage of the operation a suitable amount of scale is added. The arduous work of the puddler who must during the greater part of the puddling operation vigorously stir or rabble the charge, is done away with all together, being replaced by causing the furnace to revolve back and forth, and the liquid iron to flow over a dam which divides the furnace longitudinally in two compartments. This repeated flowing of the metal over the dam from one compartment into the other causes a thorough mixing of the iron with the oxidizing slag and therefore a quick refining. When the metal comes to nature, *i. e.*, when small solid grains of iron begin to form, the continued motion of the furnace causes the coalescence of these grains into one solid mass which is then discharged through an opening in the furnace provided for that purpose.



The new puddling furnace shown in cross and longitudinal section

This mass of iron mixed with slag, generally known as a puddled ball, is then passed through the rotary squeezer, in which it is compressed and from which it emerges in an elongated form called a bloom. This operation results in a greater compactness of the metal and in elimination of a large excess of slag. The puddled bloom may then be subjected to the ordinary treatments generally applied to wrought iron.

It would be of little avail to have devised a method by which to reduce the cost of wrought iron and to increase its production unless the quality of this cheaper wrought iron was in no way inferior to the product of the puddling furnace. An examination of the new process reveals the fact that the metal is in every way equal to the product of the old puddling furnace, and some arguments might even be advanced tending to show that it is of superior quality. This product has been exhaustively tested and it has been found that it could be made to meet all requirements and specifications demanded of wrought iron for the various purposes to which it is applied. It can be produced practically carbonless. The manganese content may be maintained below 0.4 per cent or indeed reduced to a trace, thus readily meeting the specifications for extra-refined wrought-iron bars.



The cylindrical, revolving, oil-fired puddling furnace that constitutes the basis of the new way for making wrought iron

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

A half-pound check protector

A Midget Check Protector

WEIGHING but half a pound, this check protector can be carried in the pocket or tucked in the pigeon hole of an office desk. In spite of its small proportions, as compared with the more conventional protectors, it is claimed to be fool-proof and to give real protection. The hard rubber knob, grooved to make accurate turning easier, has on its edge all the necessary figures, letters and arbitrary marks. Each figure must be set, and at the same time the handles must be squeezed and brought together This movement prints the figure in red ink and shreds the paper, thus prevent ing erasure to the same extent as any of the more elaborate mechanisms. Feed ing of the check forward for another figure takes place automatically, with the release of the plier handles.

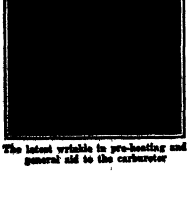
Auxiliary Gas Vaporization on a Large Scale

THOUGH its cycle of operation is rather complex, the gasoline vaporizer which we illustrate herewith does not seem to present any greatly increased probability of getting out of order as compared with the simpler devices for aiding the carburetor, and it has features of novelty which merit description. It starts its operation with an extra tube, let into the top of the gasoline tank, open to the air outside, and extending nearly to the bottom of the tank. As the gas flows or is sucked out of the tank, a vacuum effect is produced in the bottom of this receptacle; and as a result, air enters through the tube described. This air bubbles up through the fluid, and when it reaches the space above the level of the liquid, it carries considerably more gasoline vapor than the air that ordinarily occupies this space.

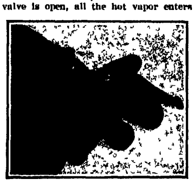
The gas-laden atmosphere from inside the fuel tank, thus abnormally enriched, is sucked through another tube into the "mixer" and past the "stove," which are jointly numbered "1" in our view The stove encircles the exhaust pipe, in the familiar fashion. The hot vapor thus provided is led next to the gasoline heater "2" This unit has an inner and an outer compartment. Into the inner one passes the liquid gasoline from the fuel tank or the vacuum tank, as the case may be, on its way to the carburetor Into the outer one flows the hot vapor from the mixer This causes the gasoline en route to the carburetor to be materially heated, so that on reaching the carburetor it vaporizes more promptly than is usual.

The hot vapor which is responsible for this is not yet through its work It passes from the heater to the distributor "3," which is attached to the carburetor under the butterfly valve When this valve is open, all the hot vapor enters the carburetor in perfect form for combustion and forms part of the mixture fed to the engine When the engine is running idle with the butterfly valve closed, a smaller tube carries the vapor direct from the distributor to the intake manifold, by-passing the carburetor

It is claimed that this arrangement keeps the engine supplied with such a hot, dry mixture at all times that there is no appreciable dilution of unburned gasoline into the crankcase oil, while the elimination of all raw gasoline in the cylinders eliminates the formation of carbon



The latest wrinkle in pre-heating and general aid to the carburetor



It looks like a cigar but it smokes like a pipe

Straightening Radiator Fins

AUTOMOBILISTS may now provide themselves with a device for easily straightening bent radiator fins and which can be used on any flat fin radiator The tool consists of three metal teeth held together by a metal handle and in use the teeth are inserted between the fins and twisted from side to side.

Glass for Footballs

A NEW kind of glass, which, if not actually unbreakable, is so tough that it has been blown into a hollow sphere and kicked about as a football without breakage, has been discovered by Dr Horak, a Czech engineer and inventor. When used in the form of tumblers the glass has successfully withstood the squirting of cold water immediately after being heated to a point where pieces of paper in the tumbler were charred. While the inventor does not claim that he has found the secret of unbreakable glass, he does believe he has found a way to make it possess the greatest resisting power of any glass so far known. It is admirably suited to the making of thermos bottles, which in so many cases have been too fragile. Plans have been made for applying it to gas masks in order to provide bullet protection to the eyes of the wearer, although it will, of course, find its principle use in more ordinary direction, such as for tableware, bottles, etc

A Pipe in the Guise of a Cigar

THE smoker who prefers a good old pipe to any other form of smoke, but who has an uneasy feeling that it isn t respectable, will perhaps be more at ease with the smoke which we illustrate This is a pipe, made in the form of a cigar It comes apart in the middle, and the further end is hollow This is filled with tobacco, lighted, replaced, and the smoker draws on the assembled apparatus just as he would on a cigar There is an air vent at the tip to permit this, and if he has been so fortunate as not to have the tobacco go out during the assembling of the "pipe," he may have a smoke in the external dress of a cigar, but possessing all the other characteristics of a pipe

The Hard-Boiled Hat

COAL trimmers, perhaps, are more exposed than any other workers to the hazard of having heavy objects fall upon them from above but in a large variety of trades this risk is present to greater or less degree An unusually successful effort to achieve protection from this sort of thing is represented by the "hard-boiled hat" illustrated This hat is made of the best grade fiber, in numerous plies, pressed and cemented together by a patented process. The crown is given a truss shape in order to stand great weight, and when advisable is further reinforced with a steel plate The entire hat is then covered with the best muslin and treated with a patented preparation making it water and acid-proof, fire-resistant, non-conductive of electricity, and long-wearing The lining of the hat is "hammocked" on the head so that it gives perfect comfort to the wearer at the same time preventing the hat from being cramped down over eyes or ears in case of an unusually heavy blow The hat itself is pliable and will fit a head of any shape It weighs from five to seven and a half ounces, depending upon the style, and is comfortable to wear under all conditions.

Perhaps the severest test to which it has been put in use came through the case of a mine engineer who was struck on the head by a weight of 12 pounds falling 15 feet. Though he was brought to his knees by the blow and the hat dented, his head was not in the least injured.

Simple tool for straightening bent radiator fins

Hardness tester for rapid and serviceable work in the shop

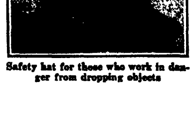
A New Instrument For Testing Hardness

THOSE who have to do with the manufacture of metal parts, especially metal cutting tools and components of light machinery, know how important is the securing of a definite degree of hardness in the material according to its use One of the disadvantages of the Brinnel instrument is its lack of portability and its unsuitability for dealing with thin and fragile articles The instrument under review has been designed with a view to overcoming these and other shortcomings of the better known hardness testers.

The tester is designed as a pendulum oscillating about its central position. The ball which is of ruby or steel is one millimeter in diameter and is held in a chuck in the center of the instrument. Six screwed weights enable the position of the center of gravity of the instrument to be adjusted to coincide with the center of the millimeter ball. The graduated weight seen in the center can be raised or lowered, enabling the center of gravity of the whole to be brought to a definite distance above or below the center of the ball, the exact distance being shown on a scale This distance constitutes the pendulum length which for standard tests is one-tenth of a millimeter With this length a single swing on a very hard surface has a duration of 10 seconds.

It will be observed that at the top of the frame there is a bubble and scale Having set up the instrument on the part to be tested it is tilted (to the right) so as to bring the bubble to zero on the scale. On release it will swing back, then to and fro till the energy is expended and it comes to rest. The harder the material the longer will it take to come to rest and incidentally the greater will be the first oscillation

This action enables the hardness of the specimen to be ascertained either



Safety hat for those who work in danger from dropping objects

Applying the automatic windshield cleaner to the trolley

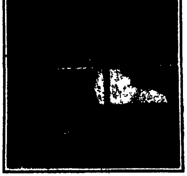
from the magnitude of the first swing or from the duration of a definite number of swings.

In the scale test, the amplitude of the first oscillation may be read off on the scale and the position of the bubble denoting the work done by the ball on the specimen, is a direct indication of its hardness. For instance, 97 is glass-hard, hard steel reads 88, brass 14 and lead 0. The effect of tilting the instrument is to elongate the indentation made by the ball when it is placed on the specimen and the distance it rolls back along the groove so formed is indicated by the scale from which the hardness is deduced.

A time test is more usual for it gives uniform and concordant results without the necessity of accurate leveling or extreme smoothness of surface. It involves a "time hardness number," which is the time in seconds (stop watch essential) taken in making ten single swings. For material glass-hard the time is 100 seconds, soft steel 20 to 40 and so on down to lead 8.

To take this test the instrument is set upon the specimen with the bubble near the center, or graduation 50, and caused to oscillate through a small arc and the swinging time taken as before stated. The time of the oscillations is, within limits, independent of the magnitude thereof.

The overall size of the instrument is 12 inches and the weight either two or four kilograms. The former has a ruby ball and is used for delicate work, the latter with a steel ball is used for general workshop purposes. The span for clear working is six inches. Articles of an awkward shape can be supported in a ball vise, while flat specimens are simply dealt with on the leveling table of the apparatus.



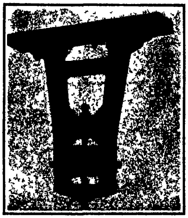
The device that whistles a warning of "low gas"

Clear Vision Ahead for the Motorman

AUTOMATIC windshield cleaners were first devised for use on automobiles, the drivers of which must be able to see where they are going. Vehicles that run on tracks can be run in comparative safety, even when the man in control cannot see where he is going, but when it comes to trolleys operated in busy thoroughfares, it is necessary for the safety of others that he see when it is proper for him to go there. The Cleveland Street Railway Company was the first traction interest to adopt the window cleaner illustrated, giving the motorman a clear view of the road ahead of the car no matter what the weather. Louisville has followed suit, and the device looks like one that merits general introduction. As the photograph indicates, a small electric motor is provided, which keeps the wiping element in constant motion, requiring no further attention from the motorman than the initial throwing of a switch.

For Hanging Shafts

RECENTLY there has come on the market a pressed steel shafting hanger of very pleasing lines and good engineering construction. It is of the four-point set screw type, and has a swing yoke which readily permits the removal of shaft or bearings. The main frame is of two stampings placed face to face, with in turned flanges extending the entire length of the leg. These flanges provide unusual strength and rigidity. The cross-brace is integral with the legs themselves. All nuts, bolts and set screws are of standard sizes. The general appearance is very good, with smooth frame and rounded surfaces that eliminate dust pockets and projecting parts.



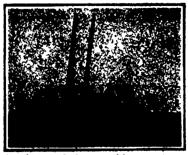
An interesting shaft-hanger of pressed steel

An Audible Gas Signal

WE have more than once described devices intended to remind the forgetful motorist that his gasoline supply is approaching extinction. The latest thing of the sort actually shouts the warning at him. It is of the general type, already noted, having a long and a short upright tube in the bottom of the tank, with gas flowing normally out of the long tube, until the level of the liquid falls to a point such that it can flow out of the short one. But it departs from the usual standard of this type, both in arrangement and in modus operandi. The principal point of difference lies in the fact that the long tube is inverted as pictured. There is suction on the long tube, even after gas ceases to flow through it, and this suction operates a whistle. So when his car begins to whistle at him, the absent-minded motorist looks for the familiar bit of red or orange at the wayside that in motoring code means "Gas sold here."

An Efficient Scarifier

AMONG the season's novelties is a new piece of paving equipment put out by a prominent Cleveland concern that specializes in apparatus for the road contractor. As illustrated, it is seen to be, in general terms, a scarifier. It has been found particularly useful in scarifying subgrades preliminary to mechanical subgrading. It may also be used for all the scarifying found on the average road job, being built very heavy to stand up under such service. Some contractors are using it in place of a rooter plow, and it is finding a place in the maintenance work of many road departments. It carries five teeth, and equipment furnished with the machine includes two complete sets of these teeth, plus one special manganese-steel tooth for extra heavy work. The machine weighs about 1300 pounds, and is furnished for tractor or team hitch.



Another tool for wrecking roads in preparation for repaving

The Spreading of Liquids

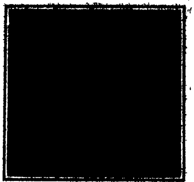
AN interesting paper by W. D. Harkins and A. Feldman on this subject appears in the *Journal of the American Chemical Society* for December, 1922. The spreading of liquids both on other liquids and on solids is discussed, and the relations worked out between the coefficient of spreading and the interfacial and surface tensions. The various terms used in the theoretical discussion are defined, experimental methods are described, and the results of numerous determinations given. Those interested will do well to consult the original paper, which is not of such sort as to be effectively abstracted.

A Problem in Thermometry

TEMPERATURE indicated by a thermometer in a medium whose own temperature is changing, presents a lag. Mr S. P Owen of the University of Durham has attacked the problem of determining this lag, taking into account the effect of the containing vessel. Complete solutions are obtained for spherical and cylindrical bulbs, with surface conductivity both infinite and finite in both cases. The mean lag in all cases takes the form of a series, of which only the first term has numerical significance.

A Signalling Window for Closed Cars

WHILE the red "stop" light is a good thing, it is not yet recognized by law, and it is likely as any other element of the car to be out of order—the editor drove ten miles, not so long ago, behind a car whose "stop" light was burning continuously. Then, too, nobody but the driver of the car behind knows whether the "stop" light was burning; the casual witnesses of a smash cannot usually see it, and the driver of the car ahead cannot possibly testify, of certain knowledge, that his "stop" light was burning. So with all its merits, this device leaves plenty of room for the good old-fashioned vogue of hand signalling.



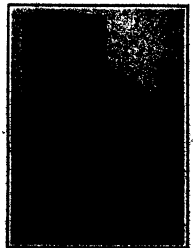
Novel type of window that makes hand signalling from a closed car easy

A Dubuque inventor, Mr W. A. Ernst, points out that the closed car is still a long way behind its open brother in the degree of freedom with which its driver can signal by hand. It's all very well to signal inside the car and trust to the man behind to see the signal through the rear window, but what when the rear seat is occupied? What, in any event, when the driver behind goes into court and states flatly that he was watching, but saw no hand signal? So the inventor in question has given us a signalling window for closed cars. It opens with a push—a mere touch, in fact, of the hand that moves outward to give the signal, and closes again with a pull on a lever or a cord or a strap—or anything else that the owner prefers, for that matter.

A New Role for the Clutch

COMPELLED to attack a difficult job in its own factory, a Wisconsin concern making disk clutches discovered a new application of their own product. They had to change the location of some of their machines in order to expedite production, and they found the usual difficulties in the installation of countershafts. It was suggested that they install one of their own clutches on each lathe, and drive a battery of eight lathes from one jackshaft. This was done, eight countershafts and eight cross-belts being discarded, and at the same time the fraying of belt edges by belt shifters being abolished for all time.

It is suggested that this new application of the clutch idea will enable every manufacturer to modernize his equipment and cut out his countershaft troubles. The clutch which served so well in the present instance is illustrated. It is a twin-disk affair, so designed that the lifting of one pin permits adjustment up to .005 inch, no tools being required. It gives a positive engagement and does not heat.



The twin-disk clutch that took the countershafts out of one factory

The latest electrical aid for the kitchen—a cream whipper

The Electric Cream-Whipper

AMONG the special jobs about the house for which a special machine is now offered is the whipping of the cream for the morning cereal or the evening pudding. The entire apparatus as illustrated, motor and beater, though purchasable separately normally comes in a single unit from the manufacturer, but, of course, the motor is available for other work. The labor of whipping cream is considerable, in unfavorable weather, and even under the best of conditions, it is a little job which the housewife will no doubt be glad to get done for her, mechanically

Filling the Radiator

WITH the aid of this neatly designed galvanized metal can or bucket, with a wire reinforcement around the top and equipped with two metal handles, the funnel, splash and drip have been eliminated in the filling of radiators. Note particularly the shape of the spout, curved so as to fit in the radiator opening, eliminating splashing and leaking. The outlet opening is large and with full weight of water behind it, these radiator fillers are exceptionally quick-emptying. The bucket holds about twelve quarts of water

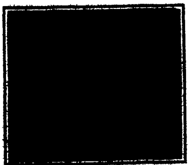
An Efficient Hand Lifting Appliance

AN efficient form of hand lifting-gear has recently been perfected. The hoist is adaptable, the absence of a drum rendering it equally suitable for a lift of two feet or 100 feet. It can be used on a jib for warehouse and garage work, or can be fitted on board a small craft as a capstan for hauling purposes.

The appliance has a capacity of one ton. An internal gear is mounted on an eccentric spindle, to which a handle is bolted. When the handle is revolved the gear is caused to oscillate in such a manner that the teeth of the internal wheel roll round those of a bevel pinion mounted in the body of the hoist. The internal bevel has one tooth more than the fixed pinion and is thus enabled during one oscillation to advance one tooth, while the chain wheel sprocket, being cast integral with it, is revolved and the load raised.

Braking and lowering are controlled by a drum and pawl mechanism, the drum being supported in the front bearing, in which it is free to revolve, but is held in position by pins.

Directly the handle is released, the pawl engages with the teeth of the drum and tends to rotate it against the pressure transmitted to the drum periphery by the load. This friction is quite sufficient to prevent the handle from reversing of its own accord, but the application of a few pounds pressure is enough to rotate the drum. It will thus be evident that the hoist cannot overrun when the handle is released during hoisting or lowering

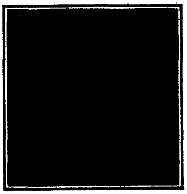


—tackle for lifting jobs, with a wide range of application

Drill and Gas Engine in a Single Unit

HERETOFORE, all power drills, of whatever type, have been limited in their application to the work by the length of an air hose or of an electric wire. Power for either of these methods must be supplied by an auxiliary power equipment which, on account of size and weight, cannot be cheaply transported, nor located sufficiently near the work to do more than 00 per cent of the drilling to which a power drill could, of itself, be profitably applied.

A Philadelphia concern is now marketing a drill driven by a small gasoline engine. It so combines the action of an air hammer and a gasoline engine that the entire drilling assembly has but two moving parts—the hammer piston and the flywheel member. No crank shaft or connecting rod is employed, and there is no spring or other yielding member. No inlet or exhaust valves are necessary, the rotary valve principle being used, with the revolving mass of the



Easy filling of the radiator, without slopping, is achieved with this specially designed bucket

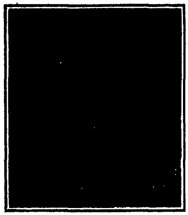
fly wheel opening and closing the ports in the cylinder at the proper moments. The down or power stroke of the hammer piston is made with some 900 pounds of explosive force from the gasoline behind it. The flywheel returns the hammer piston on the upward or compression stroke. Approximately 1800 impacts are struck per minute by this single-cylindered bit of ingenuity. Carburetion is by means of a gasoline-mixing valve which permits the engine to work at any angle. While the engine-drill runs at full speed, the operator shifts it from one position to another and to any desired angle without affecting the operation. A single spin of the fly-wheel by hand starts the drill "consistently, in the coldest weather." This looks like one of those things in connection with which the much-abused word "revolutionary" may fairly be used

Another Phonograph-Record Repeater

THE latest and most simply constructed repeater for playing phonograph records has been just patented and is now ready for distribution. This device after several experiments, has been proven not only to be practical but to be easily handled by children

This repeating device for the phonograph needs no adjusting whatever. It just sits in the center of the record over the peg, and does not touch the playing surface nor will it injure in any way the reproducer or needle. Its action is instantaneous with no break or pause between the end of one run and the commencement of the next.

As the needle at the end of the sound



This portable drill carries its own gas engine, and is tied down by no air hose or current connection

box reaches the end of the record, the tone arm is automatically carried (quick as a flash) and gently placed at the starting point

This device is made from sheet steel punchings, consisting of flat base plate, a movable arm which picks the tone arm up at the needle, operating on a cam, which is automatically returned to its original position by means of a coil spring. It is handy and convenient to apply and to use and its total weight is less than one ounce.

Permanent Automobile License Plates

ANNUALLY in the United States 20,000,000 automobile license plates go into the discard and this means that twenty millions more must be made. The cost of the making is borne, in the last analysis by the motorist. To obviate this situation, James E. Sellers of Los Angeles has designed a plate which will be permanent, so that the motorist will always have the same serial number. When the plate is first stamped it receives three extra impressions, being in the nature of depressions deep enough to countersink even with the surface the additional smaller plates bearing the date which is subject to change at the beginning of each year. The depression at the left of the serial number is dimensioned to match a small plate bearing the name of the State and the year. Above and below the number are smaller depressions for the application of whatever data the owner desires, such as his name and hometown, or his club. If desired, these spaces may be left blank. The smaller plates are attached securely and quickly by means of small screws with nuts.

A Clean-Cut Gas-Tank Filling Plug

THE necessity of a locked filling plug for the motorcar is an admission that there are few things connected with the automobile, whether valuable or of small

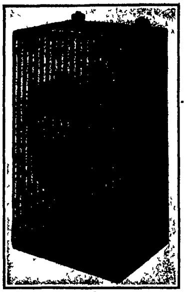
The newest phonograph repeater

value, that are not the object of petty theft. Even gasoline is siphoned from the tank and the unsuspecting motorist, returning at night, is faced with the unpleasant discovery that his tank, which he thought was amply full has run dry. As gasoline is not a particularly valuable commodity, the addition of a lock to the filler plug acts in practically all cases as sufficient deterrent to send the thief to the next unguarded car for his pilferage. In the case of patents granted to S. S. Solles of Savannah, Ga., this lock takes on a particularly neat as well as efficient form. The lock, which is of the type having a fluted key is entirely contained within the removable plug and the actual locking member or lug is placed in the plug in such a way that it is as inaccessible for tampering as is a similar type of lock when mounted on a metal door. When the key is inserted and turned the plug, which includes the lock mechanism in remarkably small space, is removed. There is no other handle for this purpose than the inserted key so that when the filling has been completed the plug reinserted and the key removed, the lock is flush with the surface of the tank, leaving no projections for prying. At the bottom of the filling member, which is tubular and about four inches in depth is placed a coarse grating which prevents large particles of matter from getting into the tank when it is open for filling

Window Washing From Within

A SEAT for which many housekeepers will not accept even a free ticket is that upon an upstairs window ledge. Fear of falling makes unpleasant the task of cleaning the pock marks of dust and soot, spotted by rain, from the outsides of the bedroom window panes. If the housewife will invest in a "third arm," however, the cleaning can be done from within the house. A long handle has at its end an elbow turned at right angles and to be used facing the glass. Tipping the "fore arm" is the "hand," which grasps a wet cloth, chamois, sponge or rubber. Afterward, a dry cloth is handed to this ever-ready model

Cleaning the outsides of those upstairs windows, without sitting out on the ledge



The "B" battery that stands up instead of lying down, thereby saving much space

servant, for the task of polishing the pane. Nor is this the only unpleasant house-cleaning job that the "third arm" will do. When the now-clean windows "show up" the dust and grime upon the wall paper a clean cloth can be used in the same tool for wiping down the walls.

Gaskets for the Piston

YOU have gaskets in numerous places about your car where oil or compression might leak out in their absence, you have packing in your pump and shims here and there and everywhere else, but your piston rings are left to make a tight fit as best they can, without any external aid. In the car of the future it may be different, we have seen at least two proposals to make it so. One of them consists in a cork-lined piston ring, the cork lining performing approximately the service of a gasket. This manufacturer makes you buy the rings to get the gaskets but another is more liberal, and sells asbestos piston seals alone, to be fitted to whatever rings you happen to have on your pistons. The claim is made in both cases that gasoline leaks and oil pumping are much more effectively checked than by plain rings of any design, and that carbon is thereby reduced and power increased. We tried the cork specimens in the editorial Tin Lizzie, and found that at least, they gave no bad effects whatever, on the extent of their good effects we were not certain, since the car was in admirable condition when they went on it.

Asbestos or cork linings for piston rings are claimed to cure many of the current automobile maladies

A "B" Battery That Takes Up Less Space

ENTHUSIASTIC—this is the word employed by the makers of a new and larger type of "B" battery, to describe the reception given the article by the radio audience. The new battery may be called a vertical battery, standing on end and having its terminals on top just like the regulation dry battery. It is four inches by three in cross-section, 6¾ inches high, and occupies less than half the ground space taken by the usual "B" battery of equal capacity. Its voltage is 22.5. It includes in its construction the features of seamless drawn zinc cans, individual cell insulation, thorough moisture-proofing and improved series connections. Its space-saving advantages are particularly noticeable when a number of units are bound together in compact sets with dry "A" batteries, and used with portable sets. Also for loud-speakers, where four or more "B" batteries are used in series to produce a high potential, the new battery is extremely convenient.

A Precision Balancing Machine

THE illustration shows a balancing machine recently placed on the market, applying the principles of dynamic and static balancing invented by Dr. B. L. Newkirk of Schenectady, so that it is possible to obtain complete dynamic and static balancing by two single corrections, individually measured and located near the ends of the body. When duplicate parts are to be balanced in production, great rapidity can be attained as static balancing is rendered unnecessary and the operator, who need not be highly skilled, has only a few simplified positive steps to perform.

A spring-mounted and pivoted frame carries a special type of headstock and adjustable rollers to support the work. By the form and location of the springs, a free vertical vibration of the frame may take place about the pivot springs as a fulcrum point. All revolving parts, including the rollers which support the work, are mounted on ball bearings. A speed of rotation above the "critical speed" of the frame is first used, and the driving power is then disengaged, permitting a gradual diminution of speed down to and through the free critical speed of the frame. From the observation on the dial indicator, mounted part way up on the column at the left, the amount of the required correction is determined.

A disk at the left of the revolving parts carries a standardized 10-ounce weight, adjustable radially by means of a vernier reading to 0.01 inch. These parts are exactly balanced when the weight is at zero. The disk is adjustable to any angle by reference to a protractor dial.

With the correction thus arbitrarily applied the machine is again speeded up and allowed to pass through the critical speed as before. The second amplitude in this process bears a relation to the first amplitude dependent on the angle between the point of application and the point required. After determining and setting off this angle, a third run will check the result. The machine is universally adapted to a wide variety of work, including balancing crank-shafts, fly-wheels, rotors, pulleys, and other revolving parts. It will receive bodies up to 24 inches in swing and 32 inches between bearings.

The machine that balances moving parts at production speed

Pump Operated From Rear-Wheel Hub

THIS novel tire pump is operated from the hub of the rear wheel and can pump up a tire in a few minutes.

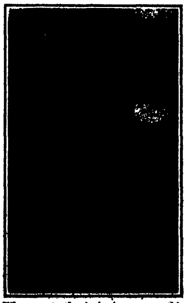
A very handy tire pump operating from the engine through a rear-wheel hub

The pump itself is clamped to the running board. The arm leading from the pump to the hub is adjustable to meet the differences in running board design, the short arm that forms the driving connection has to be supplied in size and shape fitting the hub of the given car. The pump can be used on 80 per cent of the automobiles now in use. It is clamped to the hub of one of the rear wheels and then this rear wheel is jacked up and the engine started.

Accurate Tire Inflation

A NEW tire inflating device resembles the signal apparatus on the bridge of a ship. On top of a metal standard there is an air gage 8½ inches in diameter, equipped with an indicator attached to a metal handle. By means of the handle, the indicator is placed at the number of pounds inflation desired by the motorist, in the same manner that signals are given to the engine room from a ship's bridge. As soon as the indicator is placed at any inflation point, the air is released into the tire. When the desired pressure has been attained, the air is automatically cut off from the tire valve.

The air inflator consists of a reducing air valve working in conjunction with an air gage. The indicator may be set for any pressure, from that required by a bicycle to that of a truck tire. It registers the pressure from the time the hose is applied to full inflation, eliminating the necessity of one or several tests with a small hand gage.



When set to the desired pressure, this air-stand stops the passage of air as soon as that figure is reached in the tire

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

New Source of Nitrates in South Africa

ACCORDING to the *South African Journal of Industries*, a new source of nitrates has been located on the Matsup Pan, situated in the Hague district. This Pan is remarkable in that it consists of an underground store of nitrate-bearing brine. Analyses of the brine from several boreholes showed that over 4.5 tons of actual nitrates, mostly sodium nitrate, are to be found in every 20,000 gallons of brine.

Catalysts in Glass Making

FLUORINE and antimony have the curious property of altering the thermal expansion of glasses to which they are added They appear to act in a catalytic manner as no fluorine remains in the finished glass, and although about 1 per cent of antimony may remain, it appears to be held physically rather than chemically It is volatilized from the hot glass during working, is dissolved from it by boiling water and even more so by sodium tartrate and hydrochloric acid.—*Chemiker Zeitung*, 1923, page 146.

New Alloy for Grate Bars

THE burning out of grate bars, both in the industrial boiler as well as in the domestic steam heating furnace, is a rather common occurrence In firing furnaces with mechanical stokers this has been a source of serious inconvenience A new alloy, a special variety of cast iron, has been devised which appears to overcome most of the difficulties. The new alloy is a special form of purified cast iron with a much higher melting point and tensile strength Its life is claimed to be from three to ten times that of ordinary cast iron and it pours without difficulty and does not crack The cost is only 50 per cent higher than that of ordinary cast iron.—*Jour Soc. Chem Ind.*, 1923, page 375.

Paper from Banana Refuse

A GOOD paper can be made from banana refuse, according to the *World's Paper Trade Review* The trash or refuse, consisting of the stems and leaves of banana trees from which the fruit has been cut, is passed through crushing rolls, which produces a mash in which the moisture has been reduced from 90 to 55-75 per cent The liquid is drained off and the trash is passed through a breaking or pulping machine where it is reduced to a pulp. The pulp and juice from the machine are then placed in a boiler, water is added and the mixture is boiled at a pressure of four to five atmospheres for a period of three to six hours. The contents of the boiler are then transferred to a beater, where the resinous and gummy matters, which have been set free during the process of boiling, are washed away as powder or pellets by a current of water. The removal of the fibrous material from the beater completes the process, in which no chemical is used.

Sulfite Liquor for Building Purposes

ANOTHER use for the waste liquors recovered from sulfite cellulose mills has been developed as described in the German journal, *Chemiker Zeitung*, 1923, No. 23. Loam, as sandy as possible, is mixed with about 5 per cent of hydrated lime and about 2 per cent of the waste liquors is added. About 5 per cent of technical hydrochloric acid is added to the mixture Other acids may be used as well In this manner there is formed so large a quantity of hydrochloric-silicic acid that a solid, absolutely water-resistant stone is produced When the process is altered in certain respects a product is obtained which may be used to good advantage as a substitute for tar roofing This product is more lasting than the ordinary tar roofing and furthermore it does not possess the well-known advantages of the latter By using this material the buildings may be finished off both inside and outside with the same building material and consequently the labor involved in using plaster and similar finishing materials is considerably reduced. Sulfite cellulose waste liquors can also be used to good advantage in manufacturing insulating sheets and plates, flower pots, as well as many articles made heretofore from hard rubber

War Gases Cure Disease

THE Chemical Warfare Service of the United States Army has been conducting tests at the Edgewood Arsenal to determine the possibility of using war gases, originally intended to kill, to cure disease The gases have been recommended as a cure for the diseases influenza, tuberculosis, paresis and other afflictions. Weak concentrations of chlorine gas introduced into the rooms occupied by those exposed have been asserted to prevent the spread of grip and influenza epidemics. Mustard gas has been demonstrated as a specific against tuberculosis. Tests have been made with guinea pigs inoculated with tuberculosis germs and a concentration of mustard gas, and it was found that the animals did not contract the disease The substance lewisite was experimented with and it was found that this is a remedy if not a cure for paresis and locomotor ataxia During the war the fact that chlorine could be used to prevent or cure colds, influenza or pneumonia was accidentally discovered at the Edgewood Arsenal It was remarked that cases of pneumonia or influenza did not occur in the laboratory where chlorine was being made, although 10 to 20 per cent of others on duty at the arsenal were victims Investigation showed that in the rooms where the chlorine gas was being made there was a slight leakage of chlorine, just enough to act as a germicidal agent

Double Window Panes

DOUBLE window panes, separated by a distance of two millimeters and joined together by a specially designed and patented melting process, so that no moisture or dust can penetrate between them, are used to keep out the cold in the place of ordinary double windows, according to a Swedish process. The heat insulation is perfect under these conditions.

New Alloys

NEW alloys, which are especially well suited for making propeller shafts, are described in the German journal *Gewerbefleiss*, 1923, No. 3, page 84. These alloys are made by adding bronze or vanadium brass with copper, aluminum and nickel or with copper, aluminum and iron, or with copper, aluminum and manganese Vanadium appears to combine more easily with iron, nickel or manganese than directly with copper or zinc, so that iron, nickel and manganese act as so-called intermediate media Vanadium can also be added to the metallic composition in the form of ferro-vanadium When this is done, the cost of the alloy is reduced.

Volomite, a Substitute for the Industrial Diamond

THE industrial diamond, the black bort, is replaced to good advantage by the cheaper volomite, according to a report of the Prussian Geological Institute While the product volomite is not of maximum hardness, nevertheless it has been reported that it gives absolutely satisfactory results for boring rock of medium hardness The reader is referred to the original article for further information

Tallow Trees

IN Texas there is being grown a tree which is quite new to the United States. This is the Japanese tallow tree Trees of this species bear nuts that contain a rich tallow like oil This oil has been found valuable in the manufacture of high-grade varnishes. It has been found that the climatic and soil conditions are well adapted to the growth of this tree in certain parts of Texas.

New Rust-Preventive Agent

ACCORDING to the *Umschau in Technik und Writschaft* a part of the *Vossiche Zeitung*, February 23, 1923, a new rust-preventive agent or rather process has been developed which is particularly useful in protecting vehicles and vessels. The process consists in producing a coat of metallic cadmium on the metal This film of cadmium has a thickness of from 0.002 to 0.001 of a millimeter and is produced in the electrical way by dipping the metal into a solution of a cadmium salt The coated metal part is then placed in an annealing furnace, where it is heated to a glowing heat for a period of two to three hours and in this way the deposited film is made to alloy with the underlying metal The surface coating that is produced in this manner is much more durable than the ordinary coatings produced by galvanizing with nickel, etc The color of the treated part resembles that of a silver-plated article

Blotting Paper from Wood Pulp

BLOTTING paper is generally made from rag pulp, and it is accordingly a really important achievement that has been recorded in the daily papers that a Canadian pulp mill has succeeded in manufacturing a very good grade of blotting paper from ordinary wood pulp. Blotting paper made in this manner costs considerably less than the other kind

Differentiating Hemp from Flax

FLAX is one of those products that is subject to a great deal of adulteration, due to the fact that its supply is limited and its price is high One of the substances used in adulterating flax is hemp, and this practice has been causing considerable trouble, due to the difficulty of differentiating between the two fibers. Cotton is also used to adulterate flax, but it is a comparatively easy matter to detect the presence of the cotton fiber mixed with the linen fiber under the microscope

The Linen Research Institute of England has devised a simple test whereby it is a comparatively easy matter to distinguish between the linen and the hemp fiber Considerable microscopic work was done and it was determined therefrom that the hemp fiber is developed on a right handed spiral and the flax or linen fiber on a left handed spiral If a thread is frayed out and wetted it will tend to curl up either in the same direction as the hands of a clock if it is hemp, or against the clock if it is flax If both motions are found in the same material, the so-called linen is bound to be a mixture.

Making Linen Bags More Durable

LINEN bags, especially those that are used for shipping fertilizers, are rendered more durable by dipping them into a solution of potassium silicate or sodium silicate (water glass) They are then wrung out well and dried. The solutions of the chemicals must be rather dilute For further details, see the reports of the Academie d'Agriculture of Paris.

New Mercury Deposit

A NEW vein of quicksilver said to be seven miles long and to vary in width from two to six feet has been discovered near Kita Uonome in the Goto Archipelago The ore contains 18 per cent mercury, and preliminary trials indicate that the vein increases in thickness with depth This vein is important as none of the veins so far discovered in Japan are suitable for working—*United States Commerce Reports*, Feb. 12, 1923.

Lignite Char

THE United States Bureau of Mines has made an exhaustive investigation into a process for utilizing lignite coal As is well known, there are very large deposits of lignite coal in the states of North Dakota and Texas, as well as in Canada These deposits are not being worked at the present time, but they represent potential sources of fuel which will sooner or later have to be resorted to as coal becomes scarcer The Government has realized the possibilities of lignite coal, and experiments have been made to convert it into such form that it can be utilized as a general fuel

The great trouble with lignite is that the coal contains a large amount of moisture and an appreciable amount of ash The fusion temperature of the ash is comparatively low, which makes high rates of combustion difficult and requires larger grate areas and furnace volumes than with higher grade coals In other words, the coal has to be improved first before it is possible to use it in the ordinary stove or furnace

The lignite is accordingly charred The moisture and volatile matter are driven off and a fuel is obtained which resembles anthracite coal except that it is softer and contains a little more volatile matter This makes it easier to kindle About 2.5 tons of raw lignite coal will produce one ton of char, which has a heating value of approximately 12,000 B t u's per pound The moisture is very low, and the char can be stored without any danger of fire or degradation in size.

The Heavens in September, 1923

Some Details About the Total Solar Eclipse of the 10th

By Professor Henry Norris Russell, Ph. D.

ONE event, above all others, arrests the attention of the astronomical world, and of Americans in particular, this month—the total solar eclipse of the 10th. When the moon interposes herself between the earth and the sun, on this date, she is only 227,000 miles from us, while her shadow, tapering because the sun is larger than she, extends for a distance of 234,000 miles, reaching 7000 miles beyond the earth's center, and more than 10,000 miles beyond the earth's surface on the nearer side. At this distance from the point, the shadow cone is 90 miles in diameter. An observer on the moon, looking at the earth, would then see a small dark spot on it—hardly one-eightieth of the diameter of the disk—surrounded by a region where the sunlight was dimmed, but not wholly cut off. This spot would sweep eastward across the earth's disk at a speed equal to that of the moon's orbital motion—about 2200 miles per hour. But as it moved, our imaginary Lunarian would see the earth rotating, carrying continents and oceans eastward at a speed of a thousand miles per hour on the equator, or from seven to eight hundred miles per hour in the latitude of the United States. The moon's shadow accordingly overtakes the American continent at the rate of some 1500 miles per hour, and takes three minutes and a half to move a distance equal to its own diameter. A point on the central line of the shadow track will therefore be in darkness for three minutes and a half and one could go 20 miles or so on either side without finding the duration of totality much diminished. Since the sun's rays strike the earth's surface somewhat obliquely the full width of the shadow track is a little over a hundred miles. At the edge of this belt the sun will be hidden for but a moment, while points beyond will never quite lose the sunlight. For 2000 miles on each side of the central track, however, the moon will cut off more or less sunlight, and a partial eclipse of greater or less magnitude, will be observable throughout the whole of North America.

The shadow track, beginning in the ocean south of Kamschatka, sweeps over the Pacific, just missing the Aleutian Islands, and first reaches land in California. Curiously enough, the limit of totality just grazes the coast for nearly 200 miles. A few projecting points near Santa Barbara will be in darkness, but to get a reasonably long duration, observers will have to visit the islands offshore, or else go further south. San Diego enjoys nearly three minutes of darkness, but the central line comes ashore nearly 50 miles south of the Mexican boundary. Sweeping across Lower California and crossing to the mainland, the shadow traverses Mexico to Tampico, and later passes over Yucatan, to leave the earth at sunset on the Caribbean Sea, south of the Virgin Islands.

The Eclipse in the United States

Throughout the Pacific and southwestern States the partial eclipse will be a large one, three-quarters or more of the sun's diameter being hidden. Chicago will see the sun half hidden, and New York will have a somewhat smaller eclipse. The local time of the middle of the eclipse varies from shortly after noon (Pacific Time) at Seattle and 1 P. M. at San Diego to 3.30 (Central Time) at Chicago and 4 40 (Eastern Time) at New York—the differences arising mainly from differences in longitude. To these hours must still be added the change to Daylight Saving Time where this is kept.

The eclipse will be interesting to watch anywhere in America. But its main interest centers of course in the narrow zone of totality. The spectacle there will be fine enough, aside from its scientific interest to repay any traveler for a long journey. The weird colors that bathe the landscape when only the light from the sun's edge remains; the advance of the moon's shadow, dark as the blackest storm, and traveling with the speed of a cannon ball, the sudden darkening of the whole landscape, almost as rapid at the last as a train entering a tunnel; the appearance of the stars, and of the corona encircling the eclipsed sun, and of the scarlet prominences, close to the moon's edge; and then the abrupt return of ordinary daylight and common life—all these combine into one of the most sublime of natural phenomena, memorable for a lifetime.

The sky around the eclipsed sun will be unusually starry. The sun himself is in the eastern part of Leo, about 15 degrees east of Regulus and 30 degrees west of Spica. More than this, Saturn is some 30 degrees east of the sun and close to Spica, with Jupiter some 20 degrees further on in the same direction, while Mercury is about half-way from the sun to Saturn. On the other side of the sun is Mars, about 60 degrees away, and Venus, by far the brightest of all, only 2 degrees from the sun. It is very unusual for all the brighter planets to be thus visible at once during an eclipse, and the long line of bright bodies, strung out on the ecliptic, will be a noteworthy sight.

The corona, of course, will be the central attraction. At the present time of pronounced sun-spot minimum, we may anticipate a relatively faint corona, with pronounced polar rays and long streamers in the direction of the sun's equator. For the same reason, the prominences are not likely to be conspicuous—though prediction here is uncertain.

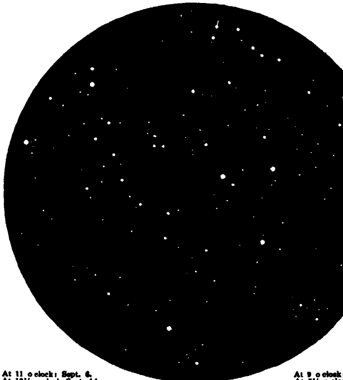
The Astronomer and the Eclipse

The astronomer, of course, will go to *observe* the eclipse rather than to *see* it—and the man who gets 10 or 15 seconds to look at the sights will be lucky. A host of observations can be made, and most of them will be attempted by one or another of the parties. Photographs will be made of the corona and prominences, and of the stars around the sun, to get one more final confirmation of the "Einstein effect." The polarization of the coronal light will be investigated, and its heat measured. Perhaps the most important observations of all will be with the spectroscope—photographing the spectrum of the lower atmosphere of the sun, at the instant when the phosphorescence has just disappeared, or is at the point of appearance, and that of the corona during totality, to secure as much more information as possible about the enigmatical bright lines in its spectrum, which are still utterly uninterpreted.

The weather conditions—always the most vital consideration—are extremely favorable, cloudiness in the early afternoon at this season being very rare. The best prospects are on the Mexican border or just south of it. The islands off the coast have some risk—though a small one—of fog; the Mexican mainland, besides having poorer weather prospects, is difficult of access.

A party from the Lick Observatory will be at Ensenada, Lower California, where English and German parties will also be located. One from the Yerkes Observatory will occupy Catalina Island—one of the most easily accessible points near the central line. The Mount Wilson Observatory—which misses being in the zone of totality by less than 40 miles—will send two parties to San Diego; one to the shore, near the central line, the other on land, near the edge, where the flash spectrum will be visible longer. Spectroscopic observations of importance comparable to the others can probably be obtained with the great tower telescope on the mountain, where about 98 per cent of the sunlight will be cut off.

Lack of space forces us this month to omit the usual brief reference to the positions of the more prominent constellations. The map will have to stand on its own feet, without explanatory text.



At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Planets

The remarkable display during the eclipse is necessarily matched by a corresponding dearth of planets in the nocturnal skies. Mercury is an evening star for most of the month, and may be fairly well seen about the time of his elongation, on the 2nd, when he is 27 degrees from the sun, and sets at 7.30 P. M.—though he is too far south of the sun to be conspicuous.

Venus is a morning star at the month's beginning, but passes through inferior conjunction on the 10th, only a few hours before the eclipse. She can hardly be seen under ordinary circumstances, for even at the end of the month she is but 6 degrees from the sun.

Mars is a morning star close to the sun on the 1st, but 16 degrees away on the 30th, and visible in the dawn.

Jupiter is still an evening star, and conspicuous, setting about 8.30 P. M. in the middle of the month. Saturn is an evening star also, but so much lower at sunset that he can hardly be seen.

Uranus alone is well placed for observation, being in opposition to the sun on the 9th. At that time he is in Aquarius, in R. A. 23 hours, 8 minutes, 6 seconds, and declination 6 degrees 27 minutes south, and is moving west 8.8 seconds and south 54 seconds per day. At the beginning of the month he is 15 minutes west and 8 minutes north of the fourth magnitude star Phi Aquarii, which may be found near the point where the western edge of the great square of Pegasus, carried southward, intersects a line joining Beta Ceti and Epsilon Pegasi. Only a large telescope will show his disk, but a field glass suffices to detect his motion among the stars.

Neptune, finally, is in Cancer, about 20 degrees west of the sun, and even the eclipse will not make him visible.

The moon is in her last quarter at 8 A. M. on the 3rd, new at 4 P. M. on the 10th—the time of the eclipse, of course—in her first quarter at 7 A. M. on the 17th, and full at 8 P. M. on the 24th. She is nearest the earth on the 12th and farthest away on the 27th. During the month she is in conjunction with Neptune on the 8th, Mars on the 9th, Venus on the 10th, Mercury and Saturn on the 12th, Jupiter on the 14th, and Uranus on the 23rd. Only the approach to Jupiter is observable, and this is far from close.

At 9 P. M. on the 23rd the sun crosses the celestial equator and enters the sign of Libra, and, as says the almanac: "Autumn commences."

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

A New Motor Pick-Up Street Sweeper

IN perfecting the present mechanically successful sweeper the engineers managed to surmount many obstacles, which formerly hampered economic operation. These mechanical difficulties common to this type of sweeping conveyor have not only been removed but a greater amount of working dependability has been incorporated.

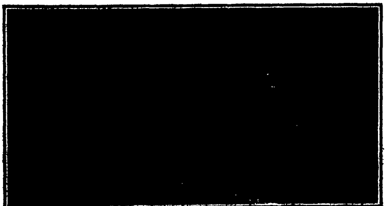
A noteworthy improvement in this sweeper is its automatic gutter broom that works in and out with the curb line, independently of the driver. The earlier types of sweeper did not have this provision for cleaning gutters with the result that additional men were required to complete regular cleaning equipment. Today with increased traffic pushing more refuse from the center of the street toward the gutters a greater need was created for a special attachment for cleaning the gutter. The gutter broom attachment was developed to take care of this need. It not only cleans the gutters more efficiently but with a great saving of labor cost as well.

The design of the large rear broom is such that wear automatically shortens the distance between the broom and conveyor. Fouling of the conveyor through breakage of the shear pins is prevented by the broom's coming to a complete stop. The conveyor is of large capacity and of the non-clogging type. Heavy sweepings are claimed not to choke the conveyor. The removable bottom, in itself a feature, is easily replaced. Only six drive chains are employed on the entire machine, including the conveyor. The sweeper can be operated while the machine is at a standstill. Mechanical parts are readily accessible. The working speed is nine miles per hour.

The new sweeper is of the four-wheel type and employs a speed wagon power plant of standard construction with right-hand drive and self-starter. It is a one-man machine with all levers so arranged that the operator has complete and convenient control without leaving his seat. The rear axle of the speed-wagon is moved forward and converted into a jack shaft, whence the drive is through roller chains to each rear wheel. An auxiliary transmission is mounted between the transmission and differential to give power for operating conveyor, large broom, gutter broom and water pump. The large broom, of steel or bamboo, is driven by a roller chain on cut steel sprockets. This rear broom is quickly adjusted to the roads and is automatic in operation after adjustment, following the pavement with just enough pressure to do good work.

The conveyor is driven by roller chain on cut steel sprockets. The conveyor itself is of all-steel construction with removable bottom. Rubber squeegees mounted on extra carbon steel angles form the flights. An efficient anti-clogging device takes all undue strain off the conveying mechanism and allows piled material to be swept without clogging the conveyor. The hopper or dirt receptacle is also of all-steel construction. The gutter broom is driven through a universal joint assembly from auxiliary transmission. The broom is steel fiber filling, built up to 42 inches diameter in six segments that are easily and quickly changed when broom is worn out. The working range is seven inches.

The water sprinkling system consists of a 150-gallon galvanized iron tank with brass strainers at intake and outlet. Water runs by gravity to rotary gear Demming brass pump which forces water to brass nozzles mounted under the bumper in front. The water spray is controlled by the driver.



The mechanical street-sweeper is self-propelled and has a gutter broom working in conjunction with the pavement broom

Gasoline supply motor trucks now being used by the New York Fire Department. These trucks are of the four-wheel drive type

New Supply Trucks for New York Fire Department

THREE new combination gasoline and oil supply tank trucks have recently been placed in service by the New York City Fire Department. These have four-wheel-drive chassis. They are the type having traction on all wheels, but steer only with the front wheels, and are the first of their kind to be purchased by the city of New York. These trucks are equipped with 900-gallon tanks with three compartments of 300 gallons capacity each. In addition, they carry four 5-gallon cans in the filler box, six 5-gallon safety cans and four 3-gallon oil cans with top stops—ample for the service they give.

It is intended that the trucks shall carry oil in one of the 300-gallon compartments and gasoline in the other two. They will be used to distribute fuel and lubricants to the various stations of the New York City Fire Department, supplying the needs for the operation of motor-driven apparatus, and should be of special value in the winter.

Motor truck touring home in camp for the night and on the road. Note the compact method of stowing the load

Motor Touring Home

ALL the thrills and benefits of a long automobile trip over mountain road or backwoods trail with the numerous comforts of home and no hotel expense may be provided by the latest motor vehicle, the motor-truck touring home. Where or how long, it matters not, for with the touring home distance and time and inconvenience are eliminated.

The touring home! What is it? It is the practical and efficient development of the dreams and ideas of thousands of tourists. In its design, the dominant idea has been to make it available to the average automobile tourist, in other words, to bring it down to what the engineers call a quantity-output basis in its manufacture. Real ingenuity has been exercised in making the equipment complete in its home appointments without being top heavy or cumbersome. Speed and flexibility of operation, moreover, are assured by the fact that the touring home is mounted on an International speed chassis.

Are the meals going to be properly cooked? How about the beds? What about rainy weather? These are questions that will at once occur to every practical-minded automobile tourist in contemplating the use of this equipment, but he needn't worry if he is going to hit the trail, this year, the "touring home" way. Every facility for properly cooked meals, real beds, just as comfortable and roomy as those at home, and complete protection against inclement weather are features that will make it a treat to travel in this latest type of home on wheels. Bodies of airplane plywood varying in length from 11 feet 8 inches to 10 feet 5 inches and in heights from 56 inches (standard) up to 76 inches with standard width of five feet are available. Two to four passengers can comfortably travel in the smaller and medium sizes and two to six in the larger vehicles.

"But how do we eat?" someone may impatiently ask at this point. Really, it's a simple matter. To the right in the rear is a kitchen cabinet, on top of this is a three-burner stove. Other cabinets contain provisions and tableware packed in such a way that there is no rattle.

"Where do we sleep?" is naturally the next question for the traveler to ask. It's an easy job to arrange sleeping quarters. First the seats, which are collapsible are put out of the way. Then the bed at the left side with full size springs is let down and opened up the full width of the car. When not in use, this bed with pillows and blankets is protected by a canvas cover. Another bed with full size mattress may be let down at the rear and held two feet above the ground by means of chains hooked on to the top of the body. When not in use, this bed is fastened against the rear of the body and is covered by a dust and waterproof canvas.

The bed in the rear is completely covered and curtained by a double tent carried on the top of the body, which in the daytime may be used as a protection from the sun when passengers wish to eat outside. Flexible windows are provided in these curtains. When it is desired to eat outside, the cabinet doors which form the table inside can be removed fitted together, and mounted on collapsible legs.

There are boxes for camping tools—all the tools are provided—convenient racks for clothing, a canvas water bottle which keeps the water cool by evaporation, toilet facilities, electric lights in fact, everything one has in the home. Everything is packed conveniently in small space, and everything one could desire is in its place. In a few minutes, one can make camp or be on the road to the next stop miles away—wherever and whenever the whims of the party decide. The enthusiastic motor traveler, in truth, can go as far as he likes and come back whenever he pleases in this flexible, convenient touring home.

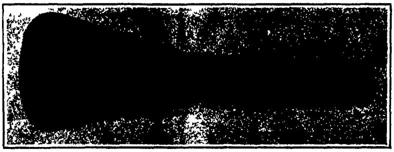
The Cathode-Ray Oscillograph

Measuring Electric or Magnetic Forces by Their Effect Upon a Stream of Electrons

By J. B Johnson

Of the Bell System Research Laboratories, Western Electric Co.

IF THE stream of bullets from a machine gun pass through a stiff squall of wind, they will strike the target at one side of the bull's eye, and this deflection will be a measure of the force of the wind In much the same way the stream of tiny electrons shot from the hot filament of a vacuum tube can be deflected by electric or magnetic forces, and if a target is put at the end of the tube, the amount of the force can be measured from the deflection it produces.



Over-all view of the tube used in the cathode-ray oscillograph

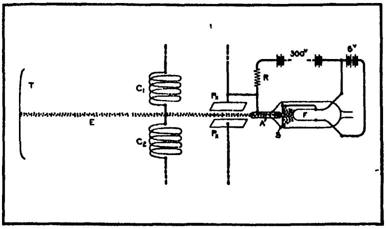
This in brief is the fundamental principle of the cathode-ray oscillograph, invented about 25 years ago by Braun, and known by his name In Braun's tube the electrons were started by a high voltage between the metal terminals which were sealed into the glass tube, which was then exhausted of nearly all the air Some of the electrons went through the hole in the plate in a tiny stream, which struck the target This plate was coated with substances which glowed when struck by the electrons, so that a spot of light indicated the end of the stream If an electric voltage was applied between the plates, the stream would be deflected toward the positive plate, and the spot would move across the screen

The Braun tube had two limitations—the air left in it was gradually used up and had to be renewed, and the voltage required was from 10,000 to 50,000 volts direct current This was not only expensive and hard to handle, but dangerous to the operator Hence the Braun tube never was used as much as its other good points deserved

With the development of the modern vacuum tube, however a way was opened to get the desired stream of electrons more easily since electrons are given off a heated filament at moderate voltages In the drawing, *F* is the filament heated by a six volt battery Another battery usually of small dry cells like the familiar radio "B" batteries, provides 300 volts between the filament and the other electrode *A* This voltage draws off negatively-charged electrons from the filament which pass through the little hole in the plate *S* The electrode *A* is in the form of a little tube, down which the electrons pass From its end they shoot off between the pair of plates *Px*, and down the vacuum space until they strike the target *T* (For simplicity only one of the two pairs of plates shown in the photographs is mentioned here The second pair is at right angles to the first, and is used to move the beam at right angles to the motion produced by the first pair of plates) One plate of the pair *Px* has a lead which comes through the glass to a terminal and the other plate is connected to the electrode *A* and so to a terminal outside the tube Thus a voltage can be put across the two plates *Px* and the stream of negative electrons will be drawn toward whichever plate is positive The movement of the spot of light which shows the end of the stream on the target is then a measure of the force exerted on the stream at the plates, and so of the voltage applied to them Since the stream of electrons has practically no weight, a change in the applied voltage is registered instantly in a movement of the spot This instantaneous feature is what makes the device so useful, because the spot will faithfully follow alternations of the voltage up to a million cycles per second or even more.

When the thing to be measured is a current rather than a voltage, two small coils of a few turns of wire are placed on opposite sides of the tube. The magnetic effect of the current will deflect the stream in a direction parallel to the plane of the coils, and the luminous spot will move just as before.

In the development of this device one difficulty was overcome in a way which gives an interesting illustration of what happens when electricity flows through a near-vacuum The stream of electrons which shoots out from the tube *A* is not like a stream of machine gun bullets, each of which flies independently of all the others. It resembles more a stream of water from a nozzle, the individual droplets of which tend to fly apart The repulsion between electrons makes the stream spread out so that it will not give a sharp spot on the target The remedy was developed by our engineers, who during their experiments made up a tube containing a small amount of gas. Now every gas is made up of separate molecules, each of which has a comparatively large central nucleus, positively charged with electricity, and surrounded with a number of negatively charged electrons held to it by electric attraction The free electrons shoot down the tube at a velocity of about 6000 miles per second, and when one of them hits one of these molecules, the force of the collision knocks off one or more electrons from the molecule. Formerly the positive charge of the nucleus was neutralized by its ring of negative electrons, but when some of the electrons are knocked off, the nucleus, now positive, begins to attract the free negative electrons. Since these nuclei are heavy and sluggish as compared to the flying electrons, they are simply buffeted around by the latter, and they stay for a time in the line of the electron stream where they were formed. Thus there is along the whole length of the stream a line of positive nuclei which attract the free electrons and hold them in the straight path, in spite of the repulsion between electrons which tempts them to spread out Further, the dislodged electrons shooting off in all directions soon fill the space outside the stream with negative charges, which repel the flying electrons and make them keep in their own path.

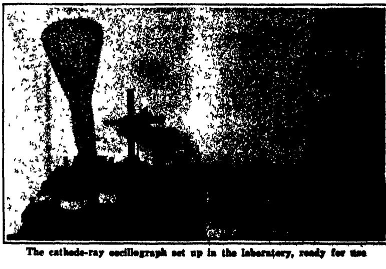


The electrical principles involved; for references, see the fourth paragraph of the text

The usefulness of this tube oscillograph comes from the fact that the stream of electrons forms a nearly weightless pointer whose movement will accurately follow the changing conditions in the circuit to which it is connected In order to be able to follow the magnitude of separate swings it is necessary to draw the beam back and forth across the target so that the path of the spot during consecutive swings will not overlap. Up to a few hundred cycles per second this can be done by waving a bar magnet back and forth near the tube Since the electron stream is really a current of electricity, it is deflected by a magnetic field just like a wire carrying a current If it is necessary to repeat the pattern, the side-to-side motion can be made uniform by rotating near the tube a coil carrying a constant current.

In most cases, however, what is wanted is the variation of a high-frequency current not with time, but as some other quantity is varied For instance in radio-telephony it is often desired to know the variation of the radio-frequency modulated current with the voice-frequency input to the modulating tube. This relation is of utmost importance as it indicates whether the outgoing waves will set up an undistorted copy of the original speech when they reach the receiving stations. In this case the circuits are so connected to the two sets of deflector plates that while the radio output moves the spot up and down, the audio input moves it sideways. According to the theory of modulation, the amount of radio current should vary uniformly from zero to a maximum as the voice current moves from one extreme of its cycle to the other

The chief value of this cathode-ray oscillograph is to get quick visible indications of what is going on in an electric circuit Thus it can be used rather to explore a situation and find out roughly what is going on, as a first step to devising measurements which will be more accurate. For example, after the apparatus is set up, hysteresis loops can be taken very rapidly on one sample after another, as against half a day each by the more accurate "point-by-point" method. Also for demonstrations before classes up to about 20 persons, this device shows what is happening with a clearness that is most convincing.



The cathode-ray oscillograph set up in the laboratory, ready for use

The Most Famous Taxi in the World

TAXICAB 2962 G-7 will never wear out nor suffer a collision, for it has been selected to represent the "taxis" of the Marne" and has been placed in a position of honor in the Invalides. The ceremonies of installation were most impressive, but the shining cabs failed for the time to cruise for fares, for they were wanted "in formation" at the great parade ground.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Chemical Processes

AROMATIC HYDROCARBON CEMENT.—W. S. Barrie and L. Chadwick, Selwyn, via Townsville, Queensland, Australia. This aromatic cement, which may be used for building purposes in general, is a chemically prepared compound as follows: Pitch, tar or any other substance which consists principally of aromatic hydrocarbonaceous matter of an aggregate specific gravity of not less than one decimal one is first brought to a temperature of 120 degrees Centigrade to 180 degrees Centigrade, to this when thoroughly heated is added in powdered form a sulfate salt while the tarry material is in a fluent condition.

METHOD AND APPARATUS FOR PRODUCING A CHEMICAL UNION BETWEEN HYDRO-CARBON GASES AND HYDRO-CARBON OILS.—H. B. Snyder, Box 43, Bridgetown, Texas. The object of this invention is to provide an apparatus by which a complete union between natural or methane gases, CH_4, and heavy hydrocarbons, such as $C_{16}H_{34}$, may be had, and thereby producing hydro-carbon compounds, such as $C_n H_{2n}$ or other hydro-carbon compounds. The method consists in subjecting a volume of methane gas to a high degree of compression, then introducing a quantity of hydro-carbon oil, and passing an electrical arc through the gas and oil while in its compressed state.

PROCESS OF TREATING VEGETABLE FIBER.—H. C. Fueller, 2001 Chateau St., N. S., Pittsburgh, Pa. The invention has for its object to provide a process for preparing Florida or Spanish moss for use as a stuffing for mattresses and the like. The process consists in the chemical removal of the plant juices from the fiber, the dyeing of the fiber and its treatment for stiffening and glossing the same, the removal of the plant juices consisting in subjecting the fiber to acid and alkaline baths.

Electrical Devices

SWITCH.—G. C. Werner, 18 Logan St., Brooklyn, N. Y. The invention contemplates for one of its principal objects the provision of a double switch provided with means which render the same capable of either mechanical or electrical actuation. A further object is to provide a switch which is simple in construction and method of operation, durable, inexpensive to manufacture and highly efficient.

FUSE PLUG.—W. P. Briggs, 212 Masonic Bldg., New Bedford, Mass. An object of the invention is to provide a construction wherein only the proper size plug may be used in any given cut-out. Another object is to provide a fuse plug using prongs, instead of a threaded sleeve, and to provide a construction of plug and socket, which will not only require the proper size fuse and plug, but will indicate the size to be used.

CEILING FAN.—M. M. Glasser, 42 Lawrens St., Charleston, S. C. The invention relates to motor operated fans, and particularly, although not necessarily, to ceiling fans, the purpose being the provision of a ceiling fan which provides simple and efficient means for effecting the bodily oscillation of the fan wheel whereby the air current produced by the fan is continuously diffused over a constantly changing area.

Of Interest to Farmers

BEET HARVESTER.—L. V. Ciraq, Box 4, Fallon, Nevada. Among the objects of the invention are to provide a beet harvester that will top the beets before lifting them out of the ground, the device having a vertically adjustable topper and frame, an adjustable width of track so that it may be adjusted to the width of row, and may at the same time be used in connection with cultivating tools, such as weeders, shovel plows, etc.

CROP DUSTING MACHINE.—C. G. Allsbury, Niagara Sprayer Co., Middleport, N. Y. The invention more particularly relates to a feeding hopper for dusting machines for applying chemicals in powdered form to growing plants. Among the objects is to provide a hopper for carrying the chemicals, and to provide agitating mechanism within the hopper which may be adjusted in such manner as to vary the quantity of chemical discharged over a given area.

TRACTOR CULTIVATOR.—C. E. Downie and G. D. Gravely, Portsmouth, Va. The object of this invention is to provide a tractor cultivator having a capacity for carrying out the various earth working operations, and adapted to be conveniently controlled by a single operator. A further object is to provide a tractor cultivator including a single traction wheel, and driven from a power plant comprising a pair of cylinders so organized as to be susceptible of driving the same through a positive train of gearing, thereby eliminating the necessity of employing universal joints.

COTTON HARVESTER AND CONVEYER.—D. Daniel, 412 E. Markham St., Little Rock, Ark. The object of the invention is to provide a cotton harvester and conveyer of extremely simple and durable construction reliable and effective in operation, to perform a maximum amount of work at a minimum expense. The apparatus combines a wagon, a fan exhaust and suction header a flexible pipe and harness to facilitate the carrying of the same by the picker.

PITCHFORK.—E. Loukkonen's, c/o T. Kronholk, Milford, Utah. The invention relates to a pitchfork wherein any of the tines may be removed and replaced at any time, the crossbar being provided with a plurality of sockets, the tines having their upper ends shaped to fit the sockets, and a pin extending through the shank for locking the shank and tine in place. In this way the breaking of a tine is not a great misfortune as repairs can easily be made. (See Fig. 1.)

ATTACHMENT FOR GRADERS.—A. Cimfl, Rice Lake, Wis. The invention refers more particularly to a supporting shoe adapted for connection with a road grading or scraping machine for the purpose of bridging wash-outs or depressions in the side of the road to prevent the rear outer supporting wheel and the blade from dropping down and cutting the depression deeper. The attachment is provided with means for adjustment and is operable by the operator of the machine.

GRASS-DIGGING IMPLEMENT.—W. L. Foss, Box 15, Windom, Minn. The invention relates to an implement for removing quack grass. An object is to provide of this character of simple and efficient construction which when drawn over a field automatically effects the complete removal of this grass from the soil. The device includes digging units for loosening the soil, and ejecting units for removing the roots.

Of General Interest

FOUNTAIN PEN.—D. La R. Eastman, 304 Waverly Ave., Syracuse, N. Y. This invention has for its object to provide a self filling pen which comprises a minimum number of parts, yet will hold a relatively large amount of ink. A further object is to provide a form cylindrical plunger to act as a self filling device. When the ink runs low the plunger and sleeve are forced downward, the pen is inserted in an ink container and the plunger and sleeve are pulled back toward their normal position, sucking ink into the barrel. (See Fig. 2.)

SUBSURFACE FISH BAIT.—W. E. Koch, Rutland, Vt. Among the objects of the invention is to provide a lure which when used in trolling will give the bait the appearance of a live fish, the bait being of such a shape as to automatically move back and forth and pull through the water in a given direction, the parts being so formed that the lure will turn on its side and zigzag continuously.

MEANS FOR MOTHPROOFING FURNITURE.—I. J. Weinberg, 3318 W. Madison St., Chicago, Ill. The principal object of the invention is to provide a means for mothproofing furniture which may be disposed along the seams of the furniture, thereby effectively protecting the entire article as it is at the seams that the moth usually commences work. A further object is to provide a device which may be disposed in any seam of the furniture, and secured as the latter is being manufactured without changing the furniture in the slight est degree. (See Fig. 3.)

ADJUSTABLE TRACK.—H. C. Kolling and W. McGill, 1147 S. Wichita St., Wichita, Kansas. The invention more particularly relates to tracks which are adapted to be placed upon a series of steps, such as those leading to a dwelling to provide a plain surface over which rollingly supported articles such as a baby carriage, or furniture may be easily moved without being subjected to shocks and jars.

MARINE PROPELLER.—G. W. Lawson, 953 72nd St., Bayridge, Brooklyn, N. Y. The invention aims to provide a construction which will increase the power of any propeller of a given size with a minimum expenditure of energy. One of the main features resides in forming the blades with a working face of substantially the same width throughout the base. A further object is to construct a propeller in which the leading edge of the blade extends in advance of the forward end of the hub to obtain an initial purchase on the water forward of the hub to avoid suction.

COLLAPSIBLE CORE.—J. F. Wallace, c/o Dept. of Water and Supply, Room 2344, Municipal Bldg., New York, N. Y. The invention relates to cores used in forming concrete tubes on conduits. An object is to provide a collapsible core so formed as to be built into a nested formation for making a plurality of openings in concrete castings for the use of electric wires or other similar use. A further object is to provide a core with hinged parts so formed as to be readily constricted for permitting removal whenever desired.

FOUNTAIN PEN FILLER.—P. S. Hauton, 30 Church St., New York, N. Y. The invention has for an object the provision of means wherein a substantially full supply of ink is drawn in upon each filling operation. A further object is to provide a filler having a collapsing mechanism for the ink sack and means co-acting with a threaded cap which will permit the cap to have a dead motion for part of the time during its operation in order to give the bag time to distend and draw in the ink.

SAFETY RAZOR.—J. J. Short, 112 W. 63rd St., New York, N. Y. Among the objects of the invention is to provide a simple form of safety razor wherein the blade may be readily inserted and removed and when in place is rigidly clamped against accidental movement, and wherein an arc-shaped edge is presented with guarding members so positioned as to prevent accidental cutting of the face.

ARTICLE OF FURNITURE.—P. Camponi, Jr., 12 E. 15th St., New York, N. Y. The invention relates to collapsible furniture of a readily portable type. The particular object is to provide a structure which may be provided with members of collapsible vertical walls, such as two walls to make a corner cabinet, or three or more walls to make a cabinet of different sizes to be placed anywhere in a room.

ENVELOPE.—Stella Benenato, 221 E. Polk St., Phoenix, Ariz. This invention relates to a means for connecting a series of envelopes, cards or other mailable matter. The object is to provide means whereby the operator of a typewriter may quickly address a large quantity of envelopes by reason of the fact that they are constantly in receiving position. The envelopes are adjusted to permit of single, double or triple spacing. The hinge-like connections may easily be removed after the envelopes are addressed. The flaps may be dampened and sealed without individual pick ups thus a great saving of time practically 108 arm movements to each hundred envelopes. (See Fig. 4.)

PHONOGRAPH RECORD.—W. C. Hadley, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y. The object of this invention is to provide a phonograph record which may be used on any of the well known phonograph machines provided with an automatic stop, so constructed that it may be possible to accurately set the stop mechanism to be operated at a definite point, and having been set, it may be permanently locked and operated with any

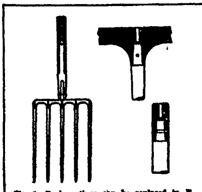


Fig. 1. Broken tines can be replaced in E. Loukkonen's pitchfork, just patented

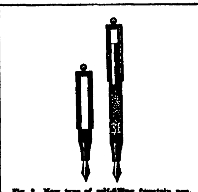


Fig. 2. New type of self-filling fountain pen, invented by D. La R. Eastman

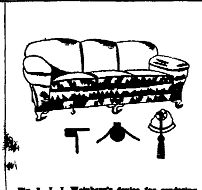


Fig. 3. I. J. Weinberg's device for rendering upholstered furniture moth-proof

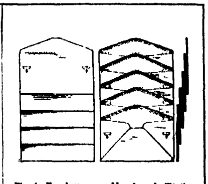


Fig. 4. Envelope assembly for facilitating addressing on the typewriter, patented by S. Benenato

Electrical Notes

Summaries and Excerpts from Current Periodicals

An Electric Locomotive, the first of a number to be supplied to the York and Northeastern Railway, is called the "Flying Scotsman." It will haul a load of 450 tons at a mile a minute.

The Electric Steam Generator is a recent product of the General Electric Research Laboratories. A cylindrical tank has a hot well below and electrode chamber above. Water is fed into the hot well and converted into steam in the upper chamber by the passage of current through the water. The purpose is to furnish steam for heating purposes at times when for one cause or another the regular heating is not economical, such as over weekends and during late spring cool waves.

Bare Aluminum Conductors.—While aluminum has been employed for some time back in high voltage transmission line work, its use as a material for heavy current bus bars or for other bare station conductors is still to be established. Recent experiences in England seem to indicate that for such purposes aluminum can be used instead of copper with a considerable saving. In addition, the weight to be supported by the insulators would be halved by such a substitution, and other advantages are gained in the matter of more ready installation and better cooling.

Eight-Hour Recharging of Storage Batteries is the main feature of a motor-generator recharging unit recently placed on the market for the use of battery recharging stations. The new unit charges batteries with current having voltage that harmonizes with voltage of battery. It handles each battery as an individual unit and will not damage a battery by excess flow of current. It recharges a battery in one fourth the time required by other methods. It will not overcharge a battery, or cause excessive gassing. There is no waste of current in this system of charging, for the battery takes its full charge and then "floats" on the line.

Large Turbo-Generators and Cheap Power.—Not many years have passed since the largest power plant in this country the Interboro plant in New York represented the last word in power plant design, with its eight enormous engine-driven units of 7500-kilowatt maximum capacity each. Stations today are designed for five or six times that capacity. Their first cost, continues *The Electric Journal*, has been reduced inherently from one-third to one-half, their efficiency has been improved some 40 per cent. A pound of coal yields to the electric light user over five times the illumination that it did 20 years ago. Turbines like those installed in the Hell Gate power plant in New York—the last word in power plants—will develop a kilowatt-hour on about a pound and a half of coal. The Interboro plant took two and a half pounds. This improvement in station efficiency, accomplished within two decades, would mean a coal saving on a 300,000-kilowatt plant of something like 600,000 tons of coal a year.

In Making an Electric Weld in commercial cast iron, says *The Engineer*, the surfaces which are to be joined must, of course, be melted. When these surfaces, which consist of iron containing carbon in both the free and the combined states, are melted, several things happen. First, all the carbon goes into solution in the molten metal. Second, some of the carbon, silicon, and manganese is burned out by the heat, while the sulfur and phosphorous are practically unaffected. The tendency, therefore, is to produce a cast iron in the weld that will be white when cold owing to its low content of silicon and carbon. Third, the surface of the molten metal oxidizes, making a slag, which partly prevents further oxidation. As soon as the welding heat is removed, the melted iron hardens very quickly, giving up its heat to the neighboring cold metal and to the air. The sudden cooling produces a chilled hard white metal in the weld, the hardness being due to the fact that much of the carbon remains in solution if the cooling is sudden. Of course, if the casting has been preheated before welding, the cooling of the added metal will not be so sudden, and a softer machinable weld may be secured.

A New Electric Condenser which has appeared in Europe is constituted by plates or ribbons of a special quality of celluloid, called cellon, upon both sides of which silver armatures are deposited by a chemical process. The cellon employed can stand 40,000 volts per millimeter and has a specific inductive capacity of four. The dielectric losses are very low, of the order of one per cent at 50 cycles. The losses at the edges are reduced to a very low value by surrounding the armature edges by an extremely thin, high resistant, border of alloy. In the case of a battery for power-factor improvement, the edge losses are reduced to 0.1 or to 0.2 per cent of the apparent power. The condenser, continues *Elettrotecnica*, takes the form of a porcelain cylinder closed by metallic caps, so that a number of cylinders can be connected in series by simply superimposing them. Applications of the new condenser are considered. The claim is made that when it is used as a "passing-through" insulator for high pressures, it allows a very efficient and reliable apparatus to be obtained. It is also remarked that, owing to the perfect adherence of the armatures to the dielectric, very silent working is obtained by the use of this condenser in radiotelephony.

Melting Brass by Electricity.—The theoretical advantages gained by melting brass in electrical furnaces have been summarized as follows: (1) Melting may take place in a neutral or reducing atmosphere, thus minimizing loss of metal by oxidation and improving the quality of the product through freedom from oxides. (2) Metal of crucible quality may be obtained without the use of crucibles. (3) Melting may take place in a tightly closed chamber, or at least in one free from the constant passage of the products of combustion of fuel, and thus losses of volatile metals, such as zinc and lead, may be reduced. Contamination by sulfur from fuel is avoided. (4) In some types of electric furnaces the temperature may be more readily controlled than in fuel-fired furnaces. (5) In some types of furnaces the molten metal is thoroughly stirred, thus giving a uniform product, even with large heats. (6) There is no handling or storage of fuel, such as coke, coal or oil, and no ashes have to be removed. The cost of power can be accurately predicted over longer periods than the cost of fuel. (7) Working conditions about the furnaces are less dangerous to health and safety of workmen, provided suitable types of furnaces are chosen. (8) The above advantages may be obtained in furnaces of larger capacity than can be used satisfactorily in the fuel-fired crucible types, with resulting greater uniformity of product, lower labor cost, and increased production.

Magnetic Separators to Recover Unburnt Fuel from Ashes.—The German firm of Fried Krupp have devised a magnetic separator for the purpose of recovering coke and unburnt coal from ashes, according to *Engineering*. Practically all coals contain iron in the form of pyrites, which has no magnetic properties. The burning of the coal, however, converts the pyrites into oxides, which are magnetic; and as the whole of the iron passes away with the slag, the metal exists there in a very much more concentrated form than in the original coal. These facts are taken advantage of to effect the separation. The machine employed consists essentially of a magnetic drum over which the furnace refuse is passed. The drum rotates slowly about a horizontal axis, just as in the case of an ordinary magnetic separator. The ashes to be treated are delivered by a bucket-elevator to a vibrating screen which separates them into various sizes. Each size is passed separately on to the circumference of the drum. The slags containing iron are held magnetically to the surface for a portion of the revolution, and then drop off into small wagons or other receptacles as the current exciting the portion of the drum which held them is automatically broken. The coal and coke which may be present do not adhere to the drum but leave its surface directly after contact with it and fall into their own receptacles. It is said that lumps of slag up to 2-inch mesh will adhere to the drum and thus be eliminated from the fuel.

Miscellaneous Notes

Odd and Interesting Items from All Sorts of Sources

Selling Bells by Phone.—Listening by long distance telephone from Boston to the tolling of several bells at Troy, N. Y., enabled a church committee deputed to purchase a bell to make a decision without the expense of a trip to the factory

Americans to Print Works for Blind.—William Nelson Cromwell, President of the American Committee in Aid of the War Blinded, has bought the mansion of the Duke of Clermont-Tonnerre in the Rue de Lauriston, Paris. Here will be installed the greatest Braille printing works on the continent for the free distribution of printed matter to the blind.

European Daylight Muddle.—Tourists are going to be bedevilled all summer with the vagaries of European time. Summertime began in England on April 22, in Belgium on April 21, Holland, Germany and Spain were undecided and France has decided against it, so the railroad authorities are in a terrible muddle. France now has Strasbourg time half an hour in advance of Greenwich Standard.

New Way to Cut Conch Shells.—A successful mechanical process for cutting conch shell has just been invented in India, according to Vice Consul Harold Shantz, Calcutta. The new invention consists of an elastic composition grinding disk, which cuts through the shell in a manner much more satisfactory than any of the high-speed disks of various metals tried before. This invention is of considerable importance because the shell, apart from its sacred significance, forms the basis of a large and profitable industry in many centers of India, where it is cut into rings, bracelets and other shapes.

Armor for Police.—The war resulted in a reversion to the armor of mediaeval and post mediaeval times, and if it had continued for any longer period the developments along this line would have been still more pronounced The so-called "siege police" in Paris have been equipped with a new armor which greatly resembles the old models. A steel breastplate is made of laminated steel attached to which there is an "apron effect" reaching to the thighs. The head is protected by a helmet perforated with peepholes. The armor has successfully withstood revolver bullets at a distance of 85 feet, which is fairly near for riot duty

Turning Out Letter Boxes in Naval Gun Factory.—In line with the Administration's program of rigid economy in all governmental expenses and as an echo of the armament conference, the big naval gun factory of the Washington Navy Yard has been converted in part into a letter box manufactory This is the first time in the history of the department that it has been independent of outside manufacturers. Under the agreement with the Navy Department the boxes of steel, brass and zinc are obtained at the actual cost of making, and at the same time work is provided for employes who otherwise would be out of jobs.

Newfoundland Iron Mines Closed.—Work has recently been suspended indefinitely at the iron mines on Bell Island, in Conception Bay, Newfoundland, and about 1600 men have been dropped Apparently there is no present market for the ore. The last shipment of 6500 tons left the island on January 12 for Germany, completing an output of 750,000 tons, or 100,000 tons more than the contract called for Previous to the war the average annual shipments of iron ore from Bell Island to the United States amounted to about 800,000 tons, most of which went to Philadelphia, but now there are no shipments.

Thermit Welds by Lighthouse Service Employes.—Repairs to York Spit Light Station, Va., on account of damage by collision, were recently completed. These included a thermit-weld repair of a broken casting of one of the bearing piles of the structure. This was accomplished successfully and without employment of specialists. When the lighthouse tender arrived work was immediately started, making the mold box and preparing the mold. Twelve hours actual labor was consumed in the work. It was necessary to work continuously after arriving at the station, as it was inadvisable to make the mold and allow it to stand on account of the danger of the heavy seas wetting the materials in the mold, which would have necessitated repeating the entire process.

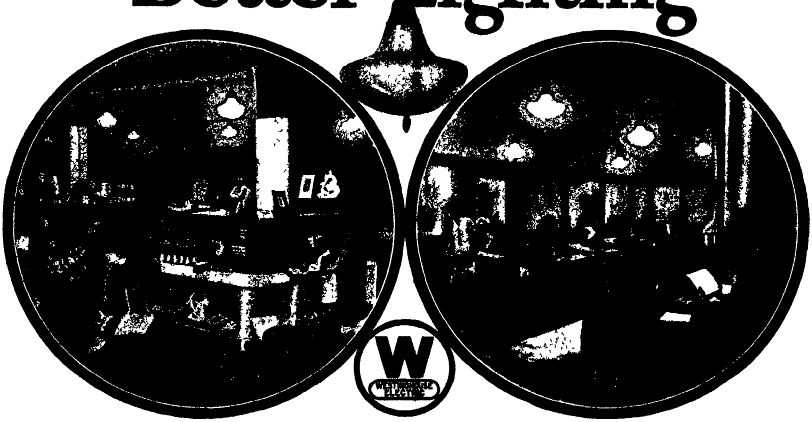
Orange Exporting Countries.—Spain, Italy and the United States are the heaviest exporters of oranges. In 1920 and 1921 Spain exported 7,000,000 boxes and 12,000,000 boxes, respectively, as compared with 16,000,000 boxes in 1913. Shipments from Italy for both 1920 and 1921 were close to 3,000,000 boxes, this amount being only a little less than for the pre-war year 1913. In 1921 the United States exported over 2,000,000 boxes, or more than double the exports in 1913 and 45 per cent more than the exports in 1920. Imports into the United Kingdom were about the same in 1921 and in 1913, or approximately 8,000,000 boxes. The imports into France amounted to 3,000,000 boxes for both of these years.

Regenerated Beverages.—The country is being flooded with circulars worded in the most abominable English. Here is a specimen: "It will not happen often that an offer of such solidily (*sic*) reaches you" After this preamble you are told that you can have 2½ gallons of Rhine wine, Moselle, etc., or "Beer of Munich" with "guaranteed fullbodied production," whatever that may mean "Or if you want something stronger you can make a gallon of whiskey, chartreuse or Benediktine (*sic*) for the same money—two dollars. Samples are not shipped and orders must be accompanied by U S. currency" Probably there are many who will learn their lesson in chemistry that alcohol cannot be made by a powder Barnum was right.

Copper to Preserve Rope.—The Copper and Brass Research Bureau says that recent experiments by the United States Bureau of Fisheries indicate that copper will be used in the future for preserving rope instead of tar, which is used at present. Impregnating rope with tar does little good, for the marine pests literally "eat the tar out of" the rope and then devour the rope itself Consequently, the 200,000 fishermen in this country who use annually about 200,000,000 pounds of rope have found rope renewal a costly item of expense. Recent experiments by the United States Bureau of Fisheries having demonstrated the efficiency of the copper-treated rope, arrangements have been made to place it on the market in the near future. The copper is applied in a solution of oil. Bulking less, weighing less and costing less to apply than tar, copper looms large as the rope preservative of the future.

The "Universal" and the Fireman's Gas Mask.—The army gas mask as developed during the war gave protection against all the poisonous gases, vapors and smokes encountered on the field of battle. But when, after the war, army type gas masks were advocated for use in metallurgical, chemical and other industries where noxious gases or fumes occur, the Bureau of Mines immediately pointed out that the masks gave no protection against ammonia gas used in refrigerating plants, or against carbon monoxide, water gas and coal gas. Recently special gas masks having canisters containing absorbents designed for protection against ammonia or from carbon monoxide have been developed, but these afford little or no protection against other gases. To combine efficiently in one canister the absorbents for all noxious gases is difficult because the absorbents for certain gases are best when moist, whereas an absorbent or catalyst for carbon monoxide can be used only when perfectly dry Hence it becomes necessary to use dry absorbents for the other gases. After an extended series of experiments and tests the following dry, granular absorbents, arranged in order of the passage of air through the canister from bottom to top were used for the "Universal" gas mask: 1. Activated nut charcoal. 2. Filter of cotton wool. 3. Caustic soda impregnated on pumice. 4. Filter of cotton wool. 5. Fused calcium chloride. 6. "Hopcalite," a carbon monoxide catalyst which causes oxidation of carbon monoxide to carbon dioxide. 7. Silica gel. 8. Filter of cotton wool. Technical Paper 300 of the Bureau of Mines gives detailed sections of the canister, also the "fireman's" canister which is smaller and lighter.

The Earning Power of Better Lighting



The merchant knows it, the tenant knows it. They have seen the results in increased sales and increased efficiency.

But many readers of Scientific American who *erect* and *lease* office buildings and stores may not have realized that better lighting results in more profitable use of floor space, better tenants, larger rentals and fewer vacancies.

The Westinghouse Illuminating Engineering Bureau can give interesting evidence on this point. You can reach them promptly through any Westinghouse District Office.

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Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Saving Our National Parks.—The American Association for the Advancement of Science went on record at the recent meeting as urging the complete safeguarding in perpetuity of all national parks in the United States and Canada against every economic or commercial use of whatever kind.

Interference with Paris Observatory.—The famous Observatory at Paris may have to be moved outside the city limits on account of the tremors due to the subway The Academy of Sciences are attempting to find a remedy and if they are unsuccessful the Observatory will probably have to move.

Colored Flowers Tabooed in Rome.—Now artificially-colored flowers must not be sold in Rome and painting the lily will probably soon be a lost art. The pure food law was applied to flowers as well, and sellers who purvey "faked" flowers will lose their licenses.

Rattlesnakes to Be Gassed in U. S. Army Experiment.—Mustard gas, phosgene and chlorine, deadly accompaniments of war, will be turned upon large dens of rattlesnakes in the vicinity of San Marcos, Tex. The experiment is to be made by special order of the chief of medical warfare, Washington, D C.

The British Museum is conducting investigations as to the best methods of cleaning and restoring exhibits of various kinds and the reports covering the same are of great interest dealing with prints and pictures, objects of stone, earthenware, silver, iron, lead, copper, bronze and wood. The problems still awaiting solution are very numerous and varied.

Many Poisonous Plants.—Although poison ivy is one of the worst offenders it frequently is blamed for poisoning caused by other plants. The Department of Agriculture has a list of more than 100 of such plants that grow in this country, and it is probable that there are others that may be poisonous to some persons. Not all of these plants are equally poisonous, and too there is great variation in the susceptibility of persons.

Rich Radium Deposits Found in Madagascar.—Madagascar has huge uraniferous deposits which are capable of producing in the near future 40 to 60 grains of radium bromide a year Ten tons of "betafite," the name given by Prof. Lecroix to deposits found in the Betafo district of Madagascar, furnish 15 grains of radium bromide. He adds that the crystals from which the radium bromide is obtained are found conveniently in red earth, and may be extracted by washing, as in the case of gold bearing deposits.

Deciphering Charred Documents.—Mr Raymond Davis, of the Bureau of Standards, Washington, finds that the written and printed matter of papers that have been thoroughly charred, as, for example, by being heated in an iron box or safe, may be deciphered by placing the charred sheet in contact with a fast or medium plate for a week or two in the dark and then developing as usual. There appears to be an emanation that affects the plate except where the charred ink acts as a protective coating. It is curious that films need a much longer contact than plates, and that sometimes the effect is reversed unless the film is previously washed and dried.

Sir Christopher Wren.—The bicentenary of the death of Sir Christopher Wren was celebrated in England on February 26. Several thousand persons attended the memorial service in St. Paul's, London, the audience including many prominent British, French and American architects. The memorial address was delivered by Dean Inge of St. Paul's, who lauded Wren, not only for his preeminence in architecture, but for his versatility in mastering other sciences, such as mathematics, astronomy and psychology Having mastered other sciences, Dean Inge said "that rare and early prodigy of universal science" took up his greatest work in middle life, and from then on his artistic genius found its expression in "the frozen music of architecture."

Damage by One Bush, $10,000.—A special study to determine the extent of infection and loss from a single bush was made by one of the State leaders of barberry eradication. The outbreak of stem rust which started from a known bush traveled in one direction, at least, for about five miles. The total wheat area affected on 18 different farms was 968 acres. The average yield for that year was only 37 per cent of what it would have been without the black stem rust, or a total loss in yield of 12,520 bushels. At a dollar a bushel the combined money loss from this single bush in this one direction was $12,520, or an average loss to each farmer of $696 worth of wheat. A barberry bush with a $10,000 potential damage possibility can be destroyed with ten pounds of salt or an hour's work with a grub hoe.

A Balloon Pioneer.—On April 7 occurred the centenary of the death of the French physicist, Jacques Alexandré César Charles, the pioneer of scientific ballooning. He was born in 1746. Charles began life as a clerk in the Ministry of Finance. He devoted his leisure to scientific pursuits and he became known as a lecturer and experimenter In 1783, a few months after the brothers Montgolfier had made their first experiments with the hot air balloon, Charles conceived the idea of filling a balloon with hydrogen. His first important demonstration was made on December 1, 1783, when Charles and his companion, Francis Robert, rose from the gardens of the Tuileries to a height of 9000 feet. Charles made his hydrogen by the action of sulfuric acid on iron. To him is due the invention of the valve, the car, the use of ballast and the employment of rubber for rendering the silken envelope gas tight. He was also the first to use the barometer in a balloon.

The Baluchitherium.—The American Museum of Natural History has recently placed on exhibition in the foyer hall the skull of the famed dinosaur, Baluchitherium, a huge extinct rhinoceros-like animal found in Mongolia by the Third Asiatic Expedition. This skull was found in the Tsagan-Nor district on the flanks of the Altai Mountains, and was transported on camel back over a thousand miles across the desert of Gobi to Kalgan, the nearest railhead, thence by rail and steamer to New York. It arrived at the Museum still partly buried in coarse sandstone The rock was chipped and scraped away, the broken parts of the bone mended, weak or shattered parts strengthened, and the missing parts restored in plaster which is colored and finished differently from the bone or teeth so that it can easily be distinguished. One side of the skull is mostly restored, using the other side which is nearly complete, as a model. Of the lower jaw there were only two pieces and the remainder was restored from the jaw of a related but somewhat smaller genus.

Abnormal Botanical Growths.—A special exhibit of abnormal growths taken from trunks, branches, and roots of trees and shrubs has been arranged in Museum IV at Kew Gardens, England. The specimens include burrs, witches' brooms, deformed leaves, contorted stems, fasciated shoots, deformed roots, and other items. In some instances the deformity is due to injury at an early period of the plant's life, in others (as in fasciation) it may be caused by luxurious growth, while deformed leaves may sometimes be a reversion to a former type. Witches' brooms are usually caused by irritation set up by fungus or insects. They are very common on birch, but occur on many kinds of trees. Burrs on trunks may follow a blow on the bark or the punctures of insects. Burrs are often very large, and the wood is prettily marked. It is in demand for furniture and cabinet work, and often commands a high price. Curved trunks are brought about by the tunneling of the larvæ of a small moth. Irregular annual rings are often caused by a tree being fully exposed to sun and air on one side and crowded on the other. Roots are often deformed by growing in gravel beds or between the bricks of walls, while the development of aerial roots on trees and shrubs may be due to an injury or to excessive moisture.

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will be noted that the sound chamber is surrounded on three sides by test chambers, and on the fourth by the shop. The test chambers are separated from the sound chamber by the test panel. To make his tests, the observer goes into the test chamber and, by means of a peg switchboard and a stop-watch switch as already described, starts the organ in the sound chamber and notes how long the sound persists through the test panel. The test chambers, it will be noted, are quite insulated from external sounds other than those transmitted through the test panels. Other tests for loudness of sound and the vibration of the test panels are also conducted.

Remarkable results have been obtained in these sound studies. Much progress was made by the late Professor Sabine up till his death in January, 1919, but since then the work has been carried on by others. In truth, the laboratory is dedicated to the task of carrying out, so far as possible, the splendid research program that Professor Sabine had laid out for its wonderful equipment. Much data has already come out of this work, and as a consequence the architectural fraternity today begins to know the acoustical properties of plaster and brick and cement and other materials which have heretofore been used in all but total ignorance of their sound characteristics.

Plasters and Sound Waves

Curves or graphs and sheet upon sheet of figures may mean little to the laity. Realistic demonstrations are the only results which seem tangible to the man in the street. That being the case, the Wallace Clement Sabine Laboratory has much to show for its five years of busy existence. Colonel Fabyan has had prepared two test rooms for a convincing demonstration of a special wall finishing material developed by the laboratory staff. The rooms are identical in size and they are virtually empty, so that conditions are practically the same in both. However one room is finished in the regulation manner with plain, smooth white plaster, while the other is finished with a rough, porous looking material developed by the laboratory staff. With the windows closed, we find that speech is somewhat difficult in the first room. Carpets and draperies would obviously aid the situation; but in all its nakedness the room has very little absorption for sound. The shrill note of a whistle persists for several seconds, indicating the marked reflection properties of the smooth walls. Then we pass on to the second room. Immediately we note how readily conversation can now be carried on, even though the room is virtually bare. The shrill whistle persists for an inconsiderable fraction of a second. Even a typewriter, which sounded like the bark of a machine gun in the first room, can be operated with a minimum of distraction in the second room.

These rooms form a permanent exhibit of the new wall finish developed by Colonel Fabyan's laboratory workers. Many an architect has been convinced of the desirability of using this new finish by a few moments' experience in these rooms. The rough finish, we are told, has the necessary properties for breaking up the sound waves and absorbing them so as to reduce reflection to a minimum. The new finish is quite pleasing, although up till recently it has been used in its plain, gray state. Now the laboratory has worked out a paint which apparently does not clog up the tiny interstices between the rough bits of the material and lends attractive soloring to the wall without robbing it of its acoustical efficiency.

Sound—what a subject! There is almost no end to the study of this branch of physics. We are captured by another member of the staff and conducted to a little room, heavily padded with felt so as to reduce sound reflection to the irreducible minimum. Surrounded by an array of radio vacuum tubes, amplifying transformers, inductances, and so on, we are told that our hearing ability is to be tested. It is learned that the laboratory is making an elaborate survey of human hearing, and that the more ears that can be tested the more accurate becomes the survey. Our ears are tested for sound intensity and for range of sound pitch or frequency. The radio oscillating circuit, giving a remarkable range of sound frequencies and a ready means of varying the intensity, proves ideal for this purpose. The readings are recorded in the form of graphs, with smooth curves in some instances and jagged peaks in others. For the author's part, one ear worked at its best when the other ear was its worst, and vice versa.

Hearing Without the Ears

At this time the Colonel's staff is anxious to show you that the ears are not absolutely necessary for the recording of sound impressions by the human brain. One of the laboratory assistants goes to another part of the building in order to speak into a microphone transmitter. You sit down in a chair, and an instrument comprising a standard telephone receiver with a steel applicator coming out of the ear cap, is applied to various bones at the base of your skull. No sounds are heard from the instrument, yet when the steel applicator is pressed against the proper bones, the sounds are distinctly appreciated—we won't say heard, but they are nevertheless clearly made out. This principle is generally known, but much may yet be evolved from it as the result of proper experimentation.

Sound—an endless subject for experimentation! We are taken to another part of the laboratory where a machine enables the laboratory workers to photograph sound waves in action. Here the acoustic researchers have studied how sound waves behave and have conducted tests with models of churches and auditoriums so as to save many an architect from the worries of architectural acoustics. Provided with a floor plan and general specifications of a proposed church or auditorium, the researchers are now in a position to approve or disapprove of any project, and to make certain suggestions which will insure positive success so far as the architectural acoustics are concerned. Indeed, guesswork and hit and miss methods are rapidly being displaced by positive laboratory methods of insuring the desired results in advance.

Tuning forks, oscilloscopes, cameras, sound analyzing machines, and other instruments complete the laboratory equipment for the study of sound. Perhaps the most elaborate piece of equipment is the sound analyzer for the study of complex sounds. This machine, consisting of numerous delicately balanced levers as well as glass balls for driving little wheels and graduated scales, was made in Zurich. It serves the purpose of graphically resolving into its components the resultant curve produced by any given sound, as, for instance, the sound of the letter *O*.

Then there is the human side of sound, already referred to. Colonel Fabyan and his workers are quite rightfully of the opinion that any study of sound is by no means complete if we do not possess a thorough grounding in the action of sound on the human system. So a part of the laboratory is devoted to anatomical work, wherein human ears are dissected and carefully mounted, with the various parts carefully tinted so as to bring out the different functions. Man made ears of brass and wood and paint have been constructed to indicate the mechanics of the human ear. Nerves, especially those in the spinal column, have been studied and specimens have been obtained and mounted for study and exhibition. There is a room at Riverbank which contains skeletons of various animals as well as humans. There is a skull which has been prepared by the anatomical staff for demonstration purposes, in which the various parts are hinged in an ingenious manner so that they can be opened up one after the other to show the different skull cavities and the formation of the bone parts.

The upper floor of the Wallace Clement Sabine Laboratory is devoted to a spacious and well appointed auditorium, where the laboratory staff meet and discuss various problems. When we visited the auditorium there were still signs on the blackboard of a lecture on the human ear, which, we were told, had been given by an ear specialist. Truly, it appears that Riverbank is already a Mecca for the scientific minds of the country to gather and impart information on the one hand and obtain information on the other.

In one corner of the auditorium we discover some kind of musical instrument, which appears to be a cross between the piano and the resident organ. There are several banks of keys. We sit down and play a few chords, and learn that the instrument is a piano. But then our laboratory staff friend manipulates a control and immediately the staccato of the piano string under the impact of the hammer, changes into the sustained tone of a pipe organ. The music, rendered either way, is delightful.

Answering our anxious query, we are told

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Botanical Notes

Dates from Asiatic Turkey.—Asiatic Turkey supplies most of the dates imported into the United States. In 1921 total imports of dates amounted to 49,000,000 pounds, of which 26,000,000 pounds came from Turkey in Asia and more than 2,000,000 pounds from Palestine and Syria.

Dr. Carver's Researches.—Dr Carver developed 165 by-products of the peanut and 115 of the sweet potato, has made potash and chinaberry meal from the chinaberry and made a tonic for stock food from vegetable products. He also devised a dressing for canvas shoes and white and colored washes from clay, has used okra fiber for making paper rope cordage, straw matting and carpet and has made 20 varieties of laundry blueing. The Spingarn medal, given annually for the most notable achievement by an American citizen of African descent, was awarded to Dr George Washington Carver of Tuskegee Institute for his remarkable researches in agricultural chemistry

Worm Holes Wanted.—An American exporter sent an unusually poor consignment of oak abroad to his oversea connection, which was found to be wormy, but no market could be found for this parcel. This consignment would have caused a great loss to the exporter were it not for the fact that the consignor happened to visit an antique furniture factory The manufacturer was at that time busily engaged in making antique grandfather's clocks, and found the oak in question to answer his purpose very nicely, because it eliminated the work of boring holes "by hand." The parcel was disposed of at a premium, and a profitable connection was established.

The Thompson Institute for Plant Research.—A statement issued recently by Dr William Crocker, Research Director of the new Thompson Institute for Plant Research which Colonel William B. Thompson is establishing in Yonkers at a first cost of more than $500,000, gave details of the plan by which powerful electric lamps are to supplement sunlight in growing plants. "This new institution with its gardens, greenhouses and laboratories," said Mr Crocker, "is to be to plants and flowers what the Rockefeller Institute is to humanity In other words, it is to study and try to cure diseases of plants and flowers and other vegetation Eventually the institution is to cost $2,500,000. Seeds from the tomb of King Tutenkhamon will be tested for germination in the new laboratory

The Oldest Living Things.—As the largest existing organisms, the "Big Trees of California" occupy a place unique among the living things of the world, said Dr H. A. Gleason, Assistant Director, lecturing at the New York Botanical Garden While they may be exceeded in height by some of Australia's gum trees, as they are exceeded in diameter by the chestnut trees of Sicily, in actual bulk, said the lecturer, they are far greater than either of these Authenticated measurements show that California's big trees have reached a diameter of over 36 feet, heights of more than 350 feet and ages well over 3000 years. Since they do not suffer from diseases and are not seriously injured either by fire or lightning, and since trees apparently do not die of old age, the usual cause of death among the big trees is by the undermining of the root system through the gradual removal of the soil by water

Less Turpentine and Resin Produced Since World War.—Figures showing the distribution of the world's production, trade and consumption of turpentine and resin have just been published. According to the best information available, says the report, the average annual production of these two important commodities since the outbreak of the war has been from 20 to 25 per cent less than it was before the war This is due chiefly to the decrease in the American supply, caused by the depletion of timber suitable for turpentine operations. The United States furnishes between 60 and 65 per cent of the world's supply of turpentine and from 70 to 75 per cent of the world's resin. The United States not only produces most of the world's turpentine and resin but also uses a larger part of it than any other country Roughly it consumes between 35 and 40 per cent of the total world supply of turpentine and about 30 per cent of the resin. Forty-five per cent of the turpentine consumption is by the paint and varnish industry, and it is estimated that an additional 40 per cent is used for thinning down paint and varnish when they are applied. Forty-two per cent of the resin is used for soap making, with the paper industry second, using about 25 per cent.

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that this instrument is not an organ in the ordinary sense. It is an electro-magnetic device in which the hammer blows are delivered by electro-magnetically-operated hammers, while the sustained notes are caused by the free vibration of the same strings actuated by electro-magnets through which flow alternating currents of the various frequencies required. Rheostats enable the player to obtain the finest kind of control of the volume. In truth, here is an instrument which permits of beautiful blending of notes not only because of the purity and the delicate handling, but also because of the remote control feature which permits of placing the strings, chimes and other sound-producing members in various parts of the building. Above the auditorium wing there is a memorial tower, in which are placed the strings and chimes, the music coming down to the auditorium with the added charm of distance. A glance in the tower discloses battery upon battery of strings, chimes, and so on, and row upon row of electro-magnets which snap away like so many small firecrackers, under control of the keys and stops in the auditorium below

From Human Nerves to High Explosives

But the Riverbank Laboratories has other studies under way aside from those dealing with the vast subject of sound. Numerous medical studies are receiving attention, some of which have already produced promising results. Col Fabyan, in his modest sort of way, tells us that his investigators have found out certain facts which even the larger colleges and universities, with all their equipment, have failed to find. He mentions an instance of a young lady who has done considerable research work in his laboratories, the results being published by one of our leading universities.

During the war, Riverbank was a veritable beehive of activity—it is that now, so let us say it was a super-beehive. Experiments were conducted along many different lines. Special buildings were erected for tests on high explosives and other military problems, the structures being today in practically the same shape as they were left when our national thoughts switched from scientific killing to better living

Then there are animals of all kinds. There are bears in a sturdy cage, monkeys in another. There are animals and still more animals, because many of the medical experiments call for tests with animals in the absence of human subjects, and even side by side with human subjects in others.

Riverbank Laboratories—a vast and remarkable institution! The more one sees of its extent and activities, the more one is puzzled as to its exact meaning. After spending the better part of the day going through one building after another, witnessing various tests and glancing through ream after ream of reports on previous activities; going through the Colonel's private museum, which contains showcase after showcase with everything from a Japanese suit of armor to a ferocious swordfish, passing by the gymnasium where the human machinery of the laboratory is occasionally tuned up, visiting the "Parlor de Junk" where various pieces of furniture and scientific equipment, which have served their purpose and are no longer required, are rebuilt and refinished by skilled workmen, and then sold to the public, generally the farmers about Riverbank, the funds going toward the maintenance of the institution, visiting the picturesque windmill in which the various cereals of the colony are ground between huge stone rollers—after seeing all these things, we felt certain that we had become quite familiar with the Riverbank Laboratories. We expressed that opinion to the Colonel, which brought forth a hearty and even boisterous laugh. For the Colonel assured us that it would require at least a week to dig down into every little corner of Riverbank and obtain a real general impression of the scope of this institution.

And to make good his statement, the Colonel, after supper in his beautiful home across the way from a group of laboratory buildings, took us to a bungalow which we had not yet seen in the course of our travels about the five hundred and fifty acres of Riverbank. There was much mystery connected with this laboratory. The staff in charge moved about like so many Egyptian priests of old guarding the darkest secrets. To deepen the mystery still further, a pretty girl was brought in. We were ushered into a small booth with dull black curtains for

walls. It reminded us strongly of our psychic experiments back in New York, when we exposed one of the leading mediums after three sittings.

At the command of the Colonel, the demonstration got under way In a few minutes we were astounded at what we were witnessing. It seemed unbelievable, yet it was there, in plain black and white. We had been brought face to face with certain facts regarding the human mechanism which we would hardly dared to have surmised in the absence of such a convincing demonstration. We were shown how—well, at this point we can go no further Colonel Fabyan made us promise that nothing would be said about the nature of this investigation until some later date, when the experiments have progressed further You see, science is a slowly-moving thing. Publicity is something to be shunned until the desired results are obtained. It may take weeks or months or years. Meanwhile, the public must wait until the scientists reach a point somewhat nearer to their objective.

So, big, startling things are being done at Riverbank, under the cloak of secrecy It is such work as this, conducted by such an institution, which will unfold to us new wonders within the next few years. We shall learn more about the human body than ever before we shall wrest certain secrets from nature which have never even been suspected a new epoch will most likely open up. Every so often the world reaches a point bordering on stagnation, because everything seems to be fully developed, just as a field, after being thoroughly cultivated year after year, exhausts itself if fertilizer is not added. But the scientist, pegging away at the secrets of Nature, sooner or later breaks down existing barriers, opens the way to a new field, and we are soon confronted with brand new opportunities for exploitation

And About the Man Behind the Idea

It would not be right to close this account of Riverbank Laboratories without a little sketch of Colonel George Fabyan, although we were told that the Laboratories were the thing to describe and that he was not to be mentioned Still, the Riverbank idea is the Colonel personified, and we must therefore sketch a word picture of this remarkable man

Colonel Fabyan, we gathered is a self made man and looks the part. He is a big man, well along in life but in the very best of health, as depicted by his rugged appearance. He has prospered in the cotton business. Although not a technician himself, he has always taken a keen interest in mechanics and medicine and other branches of science, and it has been his one ambition to establish a private laboratory for the purpose of prying into Nature's secrets. He devotes his time and much of his money to this work in memory of his mother, and we noted a tablet to that effect in one of the laboratory rooms.

The Colonel secures specialists in various lines and gives them every facility for developing new ideas and delving into old problems yet unsolved. The specialists receive full credit for the work they do. The laboratory workers live in what is called "The Community," which is a very essential part of Riverbank. In our short stay at this institution, we noted the wonderful spirit of good fellowship and happiness which permeates throughout the Riverbank Laboratories, as well as the admiration, intense friendship, and loyalty in which the workers hold the Colonel, who is ever interested in the activities of each and every worker

Confidentially, we may add in closing that the Colonel has a quaint hobby—cryptography, or the ciphering and deciphering of codes. He has gathered together and studied everything available on the subject. He has compiled codes of his own and torn apart the codes of others to learn their import. He has deciphered many old-time cryptic works, such as some of the writings of the illustrious Roger Bacon of long ago. Indeed, Col. Fabyan is considered one of the foremost cryptologists in the world today. During the World War he served as a Colonel in our Army, and maintained a school at Riverbank for the training of Signal Corps officers in cryptography The Officer grade of the Legion of Honor, the Order of the Rising Sun and other decorations, as well as rare testimonials from our own Government, bear witness to the Colonel's attainments in this quaint hobby.

And so we come to the conclusion of the story of a remarkable man and a remarkable idea which has materialized into a remarkable institution.

Sprayed Rubber

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ber as yet being coagulated by the new spraying process. The latex is collected in pans and vats on the plantations and if left in the warm sun natural coagulation takes place within 24 hours. However, most of the latex is coagulated by the addition of dilute acetic acid. As it is stirred it curdles into a mass resembling whey The curds are passed through rollers to separate out the water and it is made up into crêpe, the thin sheets that enable the buyer to see what he is buying and to judge knowingly of the amount of dirt, if any, contained. One of the faults of this process is that the acid to some extent injures the resulting rubber Another fault is that several of the valuable minor constituents of the latex, such as albumins, resins and proteins, are dissolved and lost. With the spraying process the reverse is true—the acid is dispensed with and the albumins, etc., are retained, to the advantage of the resulting rubber

Pure rubber would not be at all suited to most uses. It must be vulcanised, that is, combined with sulfur under low heat. This makes it more elastic in either extreme of cold or heat. If as much as 25 per cent of sulfur is used, hard rubber is produced. If red rubber is desired, sulfide of antimony is substituted for sulfur

The spraying process is quite different. After the latex has been collected from the trees about four per cent of liquid ammonia is added to it. This acts as an anti-coagulant. Here it is the design to keep it from coagulating rather than to produce coagulation, for in the uncoagulated state it must be sent half way around the world Those who developed the spraying process first sent from Sumatra to New York a single pint of latex with ammonia. It arrived in its original condition, so the experiment was tried next on tins, then with drums and finally, since this had proved successful, it was sent in the tanks of ships. It would seem safe to say that entire tankships may soon be used to transport liquid latex from Malaysia to this country Units for the spraying of rubber, identical with those built in the United States have been erected in Sumatra on the largest single rubber plantation in the world. This plantation is owned by one of the rubber companies in the United States. As one unit can spray some five tons of rubber per day of 24 hours and requires a crew of only one white man and three natives to operate it, the actual cost of production is quite low

When the ship carrying the latex reaches New York harbor a tankcar is shunted alongside and the rubbermilk is pumped into it. This car proceeds to New Durham, a suburb of Jersey City, N J., where one of the units of the new spraying process has been erected and has, since last February, been producing sprayed rubber The spraying unit represents what was decided on as being the most economical sized plant to operate as a unit, and any future extensions in the sprayed rubber industry will be brought about simply by multiplying the number of units. They are not interdependent. It has been calculated that all the rubber being made today in the world could be made by the spraying process in 250 of these units.

The structure which houses the rubber spraying unit consists of a truncated pyramid made of reinforced concrete. It is something under 50 feet in height and about 35 feet square, not including the sheds that surround the base of the tower The inside of this structure is divided into two stories of unequal height, the lower one forming a huge empty room about 30 by 30 on the floor and 30 feet high, with walls that have a slight tumblehome. This is called the drying chamber Upstairs is a room containing the spraying and air-heating apparatus, spare disk sprayers, latex tanks, and recording thermometric apparatus. A conical depression penetrates the floor between the two chambers so that the spraying disk may be lowered through it.

From the tankcar the latex is pumped into a large tank buried in the earth. Thence it reaches the small tank on the top floor of the unit. From this tank, whose purpose is to provide a small reserve supply in case of interruption of the pumps, the latex flows through a tube and reaches the center of the spraying disk in a stream the size of one's thumb. This disk is a round sheet of metal 18 to 20 inches in diameter attached in a horizontal position to the lower end of the vertical shaft of a small electric motor which gives it a velocity of 4000

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Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Construction of Patent Terminology.—The courts frequently have difficulty in adjudicating patents because of the inherent flexibility of the English language and often a patent suit will hinge on the meaning to be ascribed to words used to define an invention. In Standerwick vs. Kane, the Court of Appeals of the District of Columbia held that in claims which originated in S.'s application, and therefore are to be interpreted with particular reference to his disclosure, the words "substantially constant" means "sufficiently constant for satisfactory operation", in other words, that it was a practical and not a theoretical question.

Statutory and Common-Law Trade-Mark Rights.—That trade-marks are common law rights of property was emphasized by the United States Circuit Court of Appeals for the Fifth Circuit in Trappey et al. vs. McIlhenny Company. It was there held that cancellation of the registration of a trade-mark, at the instance of a competitor, as a geographical name does not preclude the registrant from asserting the exclusive right to the use of the name to designate its product to which the name is applied. Where one has marked his goods with a geographical name for so long a time that they have become known in the market by that name, the use of that name to describe goods of a subsequent maker will be restrained as unfair competition.

Use of Trade-Mark in U. S. by Foreign Company After Sale of U. S. Business.—The Supreme Court of the United States in A. Bourjois & Company, Inc., vs. Katzel has rendered an interesting decision to the effect that where "a foreign manufacturing company doing business in the foreign country and also in the United States sells its business in the United States with its good will and trade marks registered in the United States, and where the assignee goes on with the business, using substantially the same form of container and label, and importing its goods from the foreign country, the foreign company cannot rightfully come to the United States and use its old marks on goods manufactured by it in the foreign country nor can it, whether for the purpose of evading the effect of the transfer or not, arrange with an agent to sell with the old label.

Contract of Government for Use of Patent.—A decision of interest to inventors whose inventions may be of use to the Government is that of the Supreme Court of the United States in Foley, Administratrix of the Estate of Gathmann vs. United States. It seems that the inventor had offered his invention to the Navy Department, which was to test it at its own expense, and if it was found satisfactory and adopted for use, the inventor was to receive certain royalties. The court held that no contract is effected by a proposal of an inventor to give the Government the option of using his method for certain compensation, which is accepted by the statement that the apparatus will be tested, and, if it works satisfactorily, the agreed compensation will be made, where, after test, the Government informs him that the apparatus has failed, and that other methods will be used in the Government work.

Patentability in Change of Material.—Whether or not mere change of material or the adoption of a new material constitutes a patentable invention is often a moot question and no fixed rule can be laid down for it, the circumstances in each case usually controlling. The Court of Appeals of the District of Columbia (in re Curtis, decided January 2, 1923) said that where a speed governor controlled by the flow of a fluid or pulverulent material through an aperture is old and it is known that, other things being equal, the size of the device would depend on the specific gravity of the fluid or other material, the use of mercury in such a device is not patentable where the only advantage claimed is that, due to the high specific gravity of mercury, a smaller governor may be used, since this is obvious from the common knowledge that mercury has a high specific gravity and from its common use in horology.

Assignment of Patent and of Claims for Infringement Thereof.—It is quite possible to assign a patent right and at the same time make a separate assignment of rights or claims for damages for infringement of that patent. This question was passed on by the Supreme Court of the United States in Crown Die and Tool Company vs. Nye Tool and Machine Works. The effect of the decision is that where the owner of a patent executed an instrument assigning all its claims arising out of the infringement of the patent by the defendant, and all its rights of excluding the defendant from practicing the invention of the patent, the owner reserving its rights against others, and, both parties being citizens of the same State, the defendant questioned the jurisdiction of the United States Court, saying that a suit brought by the assignee under the alleged assignment does not arise under the patent laws of the United States, but is merely a suit on a contract, like one for royalties under a license, *held* that the validity of the assignment of a patent was involved, which is a question arising under the patent laws.

Infringement of Patents and Trade-Marks.—Infringement consists in the unlawful use, sale or manufacture of a patented article, without the consent of the patentee or owner, or the use by a competitor, of a trade-mark or trade name, so similar to one already in use, that confusion is apt to arise to the injury and damage of the one who first adopted and used the trade-mark.

It has been held that it is not an infringement to make a patented article simply for private experimental purposes, with a view to test the efficiency of the patent, or to improve upon the same, or for other purposes of private investigation.

The question is often asked "Before I apply for a patent, I wish to know whether my invention infringes any other existing patent." To answer this question would entail an expense which is usually far more than the actual cost of obtaining the patent. The Patent Office, in passing on an application, does not consider this question, and it is far better to apply at once for a patent and postpone the question of infringement, which, of course, may never arise, until the patent is granted. By applying for a patent, you may obtain the benefit of an official examination as to the patentability of the invention, which perhaps may be all that you require.

All good improvements are worth patenting, irrespective of the fact that their use may be found to infringe a prior patent, and many inventors have made large sums of money in selling their improvements to the owners of the original patents with which their patented improvements can be used. Infringements occur much less frequently than most people suppose, and in general unless you have some special reason to believe that an infringement exists, the best way is not to be troubled about it until someone calls the matter to your attention. It may even be that the owner of the infringing device has an invention far more valuable than the patent with which it conflicts. A good example is that of Howe, the inventor of the sewing machine, who derived a revenue which came from the owners of two infringing patents paying him a small royalty on each machine, while the net profits of the infringing companies were many times that received by Howe.

The general rule of law is, that the first original patentee is entitled to a broad interpretation of his patent claims. The scope of any patent is, therefore, governed by the inventions of prior date. To determine whether the use of a patent is an infringement of another generally requires a most careful examination of all analogous prior patents, and an opinion based upon such research requires for its preparation much time and labor. The expense of these examinations, together with a written opinion, varies anywhere from $50 to $500 or more, according to the amount of time and labor involved in preparing the same.

Sprayed Rubber

(*Continued from page 205*)

revolutions per minute. It occupies a position slightly below the ceiling of the lower chamber Here is the spectacular part of the process.

Reaching the center of the whizzing disk the rubber milk is instantly taken up and whirled from it in a cyclone of minutely atomized drops. Since they fall continuously they form an umbrella-shaped dome, a maelstrom of spray changing quickly to rubber in the intense heat of a draft of air heated to 500 degrees Fahrenheit in a brick furnace situated on the upper floor. This air is conducted down into the drying chamber by means of four large furnace pipes. The blizzard of spray rapidly drying into flakes of pure rubber may be observed in comfort through a tiny glass window let into the wall of the structure opposite the eyes as one stands on the narrow platform that runs around the tower

The great heat dries the minute drops of latex spray so quickly that no injury can come to the rubber from prolonged heating. Not only is the water of the natural latex driven off but the liquid ammonia, which was added in Sumatra, floats in gaseous form through a special port in the walls. Its odor is readily detected around the unit. Before the drying latex has reached the floor of the chamber it is rubber

The latex could be caught on the floor itself, but that would necessitate stopping the process from time to time to permit its removal. If the process is to be a continuous one the accumulated rubber must be removed frequently and in small amounts. This is provided for by covering the floor entirely with a number of narrow platforms 30 feet long by about 2 feet wide. Each platform is mounted on casters. As a filled platform is withdrawn from one side of the chamber an empty one is pushed into the other The removal is effected by a line from a small winch hooked to the respective ends of the platform and pulled, beginning with one end so that the superincumbent rubber is parted along the division between two platforms. As the coating of rubber is continuous one would naturally anticipate great trouble in doing this, but while still warm it comes apart as easily as a couple of baking powder biscuits—and resembles them in some ways.

The platform comes out into the shed covered with a blanket of clean rubber about five inches thick in the center where most of the flakes fall and tapering off to an inch at the ends. It smells like newly baked bread It feels like spongecake and if squeezed in the fingers it fails to return to its original form. Between the little flakes air is imprisoned, giving the mass a whitish or light cream color While warm it is easy to break off a chunk of the rubber, but if allowed to cool all the strength of the arms cannot tear off a sliver as large as the little finger

While still warm the large slab of rubber on the platform is broken up into pieces of irregular shape so that they may readily be handled. Twenty-five pounds of these are weighed out at one time and placed in a hydraulic press which comes down on them a moment, squeezing out all the cells of air and consolidating the sponge into a beautiful translucent mass of rubber the color of pulled taffy candy It is now solid, and extremely strong. This rubber is ready to be vulcanized and used.

A variation of the latex spraying process is being used in the manufacture of automobile cord tires. The latex fabric made by the new process has no weft threads. These are unnecessary because the cords are held rigidly parallel until saturated through and through with latex. Then this is dried into a continuous piece of rubber. The cords are led from spools through a bath of latex which so thoroughly soaks into them that microscopic examination has revealed its presence in the center or core of the little cotton fibers, none of which in the finest cotton are over 1¼ inches in length. Still maintaining a parallel relationship and, equally important, having equal tensions, these cords are led through a series of drying devices, drying the latex which is in the cotton fibers, that which is between them and that which is between the cords into a single piece of fabric which may be stretched sidewise without the least injury or permanent displacement of the cords. The fabric has been made integral with the rubber itself. The parallelism between the cords is perfect. Every cord takes up its rightful share of the strain in the tire.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

The Broadcast Central Station has now been operating in the heart of New York City for several months, and has been functioning very well indeed, especially in view of the unfavorable summer weather and the location of that station in the heart of the metropolis. The Broadcast Central is really two stations in one—WJZ and WJY The two lofty steel towers which rise some 400 feet above 42d Street, New York City, provide support for two antennae, and this super-station transmits two broadcast programs simultaneously, on different wave lengths. WJZ transmits on a 455-meter wave length, and WJY on 405-meter wave length.

Broadcasters' Correspondence.—Since the inauguration of broadcasting by WGY some sixteen months ago, the General Electric Company has received 65,000 letters from listeners scattered over the United States and from points as widely apart as Hilo, Hawaii, and London, England, Vancouver, Canada, and Valparaiso, Chile. Some of the letters are typewritten and from the offices of business and professional men and some are penciled on scraps of paper from woodsmen and from forest rangers. These letters are useful to the program director for he learns from them what type of program appeals to the majority of listeners and the letters strongly influence his decisions in building up future programs.

Marconi's Recent Work.—In a statement issued to the press on his arrival at Southampton on board his yacht "Electra" recently, Senator Marconi said that during the two months he had been away on his research cruise he has been working all the time on the system of directive wireless telegraphy, by which a message could be sent in one direction only, and he was delighted to say that experiments had proved highly satisfactory The apparatus with which he had been working was the only installation of its type, but it was likely to come into universal use in the future The results he had obtained proved that communication could be maintained over long distances. The new system, said the Senator, effectively eliminated atmospheric disturbances, and he might say that he had experienced no trouble of that sort during the whole of his two months' research. The course of the trip was roughly 2200 miles, or the distance from England to Canada.

Proposed Broadcasting in India.—According to recent dispatches, it was announced at the broadcasting conference held in Delhi that the Indian government did not intend to permit broadcasting in India by individual firms, but, under reasonable control—as in the United Kingdom—by a single licensed company for the whole of India. It is planned that this company shall consist both of British and Indian firms and that no non-British subjects will be allowed to take part in it. The proposal of the government regarding terms of the agreement required of the broadcasting company were embodied in a draft form of license placed before the conference. Opinions upon this form will be obtained from the Provincial governments and chambers of commerce. It is understood that the manufacture of receiving sets is to be undertaken in India as soon as practicable by the new broadcasting company This will probably at first consist of importation of some parts, the local manufacture of others, and assembling of complete sets.

Loud-Speaker Voice for Drill Sergeant.—If 250 lusty-lunged sergeants of the regular army should get together and shout "Fall In," in their best drill-ground style, the effect would scarcely equal that of the voice amplifier recently purchased by the Signal Corps and installed in mobile form on a motor truck. The new equipment can be used to handle large bodies of troops, to make speeches and music audible to assemblies, or to supply entertainment received by radio. The apparatus is technically known as a public address system. Sounds are picked up by a high-grade transmitter placed a few feet from the speaker, or near the bandmaster's stand, if music is to be handled. The electrical output of this transmitter is increased about a half-million times, using a four-stage vacuum-tube amplifier Then the current goes into a group of six horns, mounted on a folding tripod. Under ordinary quiet conditions, a compact crowd of 750,000 people could hear a man speaking in an ordinary voice, through the use of this system.

The Wireless Year Book.—The 1923 edition of "The Year Book of Wireless Telegraphy and Telephony," published every year by the Marconi's Wireless Telegraph Company, is bulkier than ever This may be ascribed to the advent of broadcasting which has caused an interest in radio matters to be generated in many new places. Though there has been no marked progress in scientific development during the year that most useful feature, the "Record of Development," still makes interesting and informative reading, and the value of this is much enhanced by Mr Platt's "Historical Survey" On the other hand, large power wireless stations are being constructed in every part of the world and in many ways wireless or radio is becoming more and more a part of our daily life. All this is reflected on the Year Book by an enlargement of the existing features and by the publication of fresh matter relating to direction finding. A map section shows the location of every wireless station in the world.

Radio Telephony in South America.—In Santiago, Valparaiso, and several smaller Chilean cities interest in radio telephony is growing steadily, and its fuller development only awaits the establishment of a broadcasting station within the country such as those now in operation on the east coast of South America, according to a report from the Department of Commerce. It is reported that broadcasting stations recently erected in Buenos Aires, Montevideo and Rio de Janeiro are giving very satisfactory results, and large numbers of amateur receiving sets have been sold in these countries. This is especially true of the Argentine, where conditions for broadcasting programs are almost ideal as the land generally is flat and radio transmission carries all over the River Plate district, Uruguay and in Southern Brazil on the north as far as the Andes on the west. For this reason the sale of radio equipment has met with great success in that country, and it is now estimated that there are approximately 25,000 sets in Argentine Republic, in comparison with about 100 less than one year ago.

Wired Wireless, or the application of radio telegraphy and telephony to power wires and other continuous conductors to form a "guided" system of radio communication as distinguished from the usual "unguided" system, is about to receive a practical test in broadcasting operations. There has been formed an organisation for the purpose of broadcasting talks, news, musical numbers and other features over the lighting lines of a power company in the vicinity of New York. The plan is to charge a nominal fee to the electric light consumer for the privilege of listening to the wired wireless programs. The company undertakes to supply a receiving set which may be plugged into any socket or receptacle. A simple receiving set with crystal detector and a pair of ear-phones is supplied at the lowest fee, a single-tube set is supplied for a higher fee; and a three-tube, loud-speaker set complete, giving the same service as a phonograph, is supplied at the highest fee. The tubes are supplied with filament current directly off the lighting current, from the same plug connection that receives the radio energy Plate batteries or "B" batteries are still employed, since it would require too elaborate an arrangement to do away with them, and the current consumption for the plate circuit is such that "B" batteries last for long periods. The wired wireless programs are to be of a high order, and are to cover a period of some eighteen hours out of the twenty-four. On occasion, the broadcasting station plans to pick up programs from other broadcasting stations and to retransmit them over the power lines. It so happens that wired wireless has many advantages over the usual "space" radio, among them louder signals and less static interference.

Psychic Adventures at Home

(*Continued from page 164*)

and feet roped in such fashion as the furniture makes convenient She is *supposed* to be tied in a way that she could not have accomplished herself, unaided, for while one hand and arm could have been used in tying the other, the second arm presumably could not have been tied without external aid. The medium is freed in the same way in which she was tied, after a lapse of time depending upon the pleasure of the control Other phenomena may or may not occur during the interval.

McKenzie, originally vastly impressed by this performance, ultimately learned that it was done by means of a trick tie. The right hand was tied, honestly, using the left, the left wrist was slipped into a loose noose in the rope, which was then twisted in such fashion as to give the impression, to any other than a most painstaking searcher, that it was properly tied McKenzie did not charge Miss B with conscious or even unconscious trickery He insisted that Black Cloud had been playing pranks on his own account, to have sport with the investigators.

If a trick tie were used last year, I cannot testify that it is still used this year Black Cloud announced that the tying was to be done, and the ropes were trailed across the hands of several of the sitters, while one could hear whipping sounds as they were passed around and drawn tight. When the job was completed, the red light was ordered and we were invited to examine the work. With McKenzie's findings in mind, I thought I should have been able to identify the trick tie if it were used; but I was unable to do so.

Before the tying had commenced, Black Cloud got Sir Arthur and me to exchange seats, bringing me into the place next the medium. My left hand was then picked up, brought in contact with Miss B's right, and it was to this hand of mine that her right was tied, rather than *to any of the* furniture. No question arises as to the honesty of this tie, for her hand was in my control, regardless of whether the tie were a valid one.

When the light was called for, my freedom of examination was somewhat hampered by my being thus tied to the medium, I could not pass around behind her and examine her bound left hand from all sides. *This hand was tied to the longitudinal* member of the table along which the two ends slide—the runner, I shall call it. The rope passed several times about this, and several times about the medium's wrist. Her wrist lay tightly against the runner, with a large, complicated knot in the rope between None of the loops of the rope passed clear around the wrist and the runner in one turn; every loop passed about the wrist alone, or the runner alone. *So far as* I could determine, every loop actually passed into the knot, and I could not see that any two consecutive loops passed about the wrist. If these observations were accurate, all the orthodox ways of making a trick tie from which and into which the hand could be slipped at will are covered.

While the ties were being examined, Dr Pyle produced a handkerchief and suggested that, *before* she was released, something be done with this as clinching proof of her non-participation in the actual work of the seance. Black Cloud accepted this idea, and when the light was extinguished the handkerchief lay open, on the table near the medium. Almost at once the tinkle of a tambourine was heard, and Dr Pyle announced that the handkerchief had been brought to him in the tambourine, neatly folded. Then it was gone, and after perhaps two minutes the control called for the light. When this was turned on, we had to look about quite a bit before we located the handkerchief, tied tightly around the medium's face and neck, over her mouth.

My first thought was of her left hand, and I looked again at it. So far as I could judge, the rope was arranged just as it had been before. The extreme speed with which release and retying would have had to be accomplished, in the light of the facts set down in the preceding paragraph, not alone lend some force to the argument that release and retying could hardly have been done, they likewise make it highly improbable that these operations could have been done with so little disturbance of the rope as to escape my eye.

Examination of the state of the handkerchief was, for the moment, quite staggering. This I could do with excellent effect, for the knot was on my side of the medium's face. The kerchief was smoothly and neatly folded

as it passed over her mouth and around her cheeks. It was drawn so tightly that the flesh of her cheeks overflowed very sharply over its edge, and it was with difficulty that I could slip a finger under it, at the expense of the flesh rather than of the cloth. The ends were properly and firmly and unmistakably tied, at the back of her neck.

I must confess that I was tremendously impressed. But subsequent thought brought forth one suggestion which indicates that a natural explanation is not quite so hopeless as it seemed. Tight as it was, the handkerchief could doubtless have been pulled around, moving the knot from front to back and vice versa. If the medium had a free hand, the handkerchief could, I am quite confident, have been tied, with that hand and the teeth, and with the knot in front, and then pulled around and tidied up a bit, in the position where we found it. And this not alone throws the handkerchief trick right back upon the question of whether the medium really had a hand free, but gives a suggestion that maybe the teeth were used in tying the left hand as well. I don't know just how they could have been used, but obviously they constitute a tool which we have not yet mentioned, and with an additional tool the medium, if she be a sleight-of-hand artiste, could obviously do more than without it.

The very obvious explanation of confederacy I am afraid will have to be thrown out, if this medium does her stuff by trickery, she does the tricks herself. She has never given this handkerchief performance before, so far as I know, but everything else that she did for us on this evening parallels what she has done for McKenzie at the British College, and for Sir Arthur at his home in Crowborough. None of the sitters of April 26th was present at the College, and of these sitters Sir Arthur himself is the only one who was present at Crowborough. This rules out confederacy, and I would point out that the stage magician does most of his stuff with the aid of not one, but several confederates, all over the house and all over the space back-stage. If he were left wholly on his own resources, he would have great difficulty in giving so creditable a performance as the one I am describing.

After the light went off again, Black Cloud got an inspiration of his own. He called for soft instrumental music, and the whistling voice joined in from the center of the table as usual. While this went on, the medium's right hand carried my left to her mouth. The avowed purpose of this was to enable me to verify that the handkerchief was still in place. But my hand was held, back against this handkerchief, long enough for me to make two other observations of prime importance. One was that the medium's head was unquestionably in the place where it belonged while the whistling came from the center of the table. The other was that while the whistling proceeded, the medium was breathing through her nose—gently, regularly, and *not* in time with the whistling.

The suggestion has been put forward that Miss B's independent voices are on her phonograph records. It is a very natural plea, under all the circumstances. I will not meet it by insisting that the voices come from another point than the phonograph, because, as it happens, I can do better than that. Some time ago Miss B held a series of test sittings, at which a very good friend of mine was one of the investigators. In the medium's absence and without her knowledge, the records were played, and nothing was found on them that did not belong there. Had I not known this, I should have asked permission to play one or two of them after this seance.

Well along in the seance we had another remarkable demonstration in connection with these records. Mrs. Lee, now alone and now with the aid of the controls, has been feeding music into the machine, now from one pile and now from another, ever since the beginning. Of the records offered and rejected, some must have been restored to the "live" piles, since these would surely have given out otherwise. Some tunes apparently were so restored after they had been played, since they were later repeated. In the original sorting, Miss B took the records just as they came. It seemed, therefore, quite out of the question, even if by a feat of memory she knew their order in the several piles to start with, that she could have kept track of the condition of any of the piles.

A record ran out, and Mrs. Lee replaced it. Before she had it completely on the

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machine, and hence before it had played a note, Pansy objected that she didn't want that one. Mrs. Lee asked her, with a trace of impatience, how she could tell whether she wanted it before she knew what it was. Pansy replied promptly and in unusually good voice that she knew quite well what it was, that it was "The Tale of the Roses," and she didn't want it and wouldn't have it It was laid aside for identification, when the light should be restored, being placed upright in Mrs. Lee s chair, behind the lady's back. Presently, forgetting that it was there she leaned back and cracked it. At the end of the seance, this broken record was found to be the one that Pansy had named If we admit the good faith of Mrs. Lee and the impossibility of Miss B's knowing by memory what this record was, we have here something that comes perilously close to passing the bounds of telepathy and falling in the field of pure divination

From time to time various of the sitters announced caresses or other touches, those that came to me were just about like the ones I had felt in previous seances, and call for nothing beyond the mere chronicling

That two voices never appeared at once I am quite certain, also that no two objects were moved about the table at the same time. It is my impression that several times we had lights and voices simultaneously, but of this I cannot be absolutely certain.

Several of the sitters at one time or another announced the cold breeze so characteristic of the seance room. Once Sir Arthur and I got a powerful blast of this there could be no mistaking its objective character, or the fact that it came from the direction of Miss B.

Toward the end we had a gorgeous example of table tilting Black Cloud announced it in advance, and called for all the hands to be placed in light contact, at the very edge of the table. My left was an exception, it remained well out on the table, with the medium's right beneath it. Knowing what was coming, I purposely bore down as gently as possible and twice, for my pains, I had my hand pressed more firmly upon hers, by what I took to be her left hand Aside from this, her left was unaccounted for

The table gave a few premonitory shivers, and then rose, to everybody's very positive belief entirely clear of the floor Suspended in the air it gyrated in a curious back-and-forth up-and-down fashion, which I can describe no better than *to call it a figure-of* eight motion. Presently it settled back to earth.

I handled the table considerably during the clearing for action, and I judge it weighs fifty pounds at least. I am perhaps not as strong as the medium, being built along the general architectural lines of a drink of water, but I could not come within forty miles of juggling the table as it was juggled, if I had two arms and two legs to work with, from a well-balanced position The suggestion has been made that only the top of the table was levitated, but the top displayed no tendency to come away when we hauled the table around to free the rug—and besides, I don t believe that Dr Pyle has a conjurer s table in his dining room.

The grand climax of the Besinnet seances, spiritistically speaking, is the materialised faces Here a word of explanation is in order Mr James Black once poked the finger of scorn at this medium, because one of her materialisations turned out to be Miss B herself, out of her seat and lying over on the table. Had Mr Black known a little more about the subject, he might have pointed the same finger of scorn, but from a different direction It is admitted by the medium and her supporters that the "materialisations" are not always independent of her own physical form. The claim is that when the power is good she gives off sufficient ectoplasm to form a complete face or even a complete figure; but that when the power is less, she can only produce enough of this substance to be used as a mask or veil, over the foundation supplied by her own face. Her face is then thought of as having been "molded" ectoplastically into a resemblance to the features which it is desired to present.

Now of course this seems ludicrous to the scoffer—even the spiritualist understands that, if he has retained his balance. Maybe it *is* ludicrous. But it will never be demonstrated to be ludicrous by simply calling it so, a reason for its absurdity must be produced. Until this is done, Miss B's good faith cannot be attacked by the mere demonstration that some of her materialisations are, or could be, her own face in disguise. So I shall not bother to discuss this possi-

bility at all, I shall merely describe what happened.

After the seance had been under way for a half hour or so, there occurred what the regular sitters recognised as an attempt at materialisation A psychic light was produced of different character from those that had gone before. It was more static and brighter, standing quietly in one place. A short distance away, in the direction toward the left hand of the sitter facing it, there appeared a vague object of some sort, illuminated by the light in question. To me with my lack of prior knowledge as to what it was supposed to be, the first of these objects seemed quite without form. They continued to occur, at intervals, with the light ever brighter and the illuminated object ever better defined, until I was able to assure myself that an attempt was really being made to delineate the human face.

The lights accompanying these "faces' were, at their best, of considerable illuminating power, once or twice actually making one of the sitters visible faintly to his neighbors.

One who has sat with Miss B has expressed privately to me the opinion that these lights are from a small electric torch They did not so impress me—principally, I think, because the illuminated region did not show a definite circle, also because the luminous entity itself impressed me rather as a surface than as a curve like the filament. But they do not last long, and one's attention is directed at the accompanying "face" rather than at the light, so such a verdict should be put forward with much reserve

The illuminated objects themselves, as I have said, ultimately get to the point where one believes they are meant for faces. There the thing halted for some time. Sir Arthur made desperate attempts to identify the materialisees, asking again and again to have them repeated. Ultimately he satisfied himself that one was his nephew and another his mother Sitting next him I saw these particular ones almost as well as he did, and it was my own best judgment that they were not sufficiently clear to be identified at all, save by a liberal contribution of desire and imagination on the part of the sitter

Had some convulsion cut the seance off half an hour earlier, I should have carried this impression away as a final one During the last half hour, however, I was forced to revise it. From six to a dozen faces were within this period presented, either to me or to an immediate neighbor, which were startlingly clear and which lasted long enough for one to get them in one's eye While all of these seemed in a way to be types rather than individuals, yet I was pretty sure that if any of them were the face of one known to me, I should be able to identify it. Some of these faces were female and others male types. All, I believe, had the eyes closed; repeatedly a sitter would plead "If you would only open your eyes I believe I should know you" They were quite diverse, and I did not feel that they could all be the medium's face without make-up of some kind—ectoplasmic or otherwise, as you prefer All of them were, to my best judgment, quite generalised in appearance—lacking entirely, for instance, such personality and character and distinction as I had noted in the singing voices. And herein I think, lies the danger of claims to identification.

Concerning the structure or apparent structure of the faces I should want to see more. Some if not all were surrounded by fabric-like structures similar to the "ectoplasmic arch" which Sir Arthur finds on most psychic photographs. As regards the features, my best impressions would be rather unfavorable to the suggestions involving a textile fabric of some sort. All the faces were singularly reposeful in general effect, and had the corpse appearance.

The Maple Sugar Industry

(*Continued from page 176*)

as the purest water. But it is as susceptible as milk to bacterial influence. And it is *only* by preventing the development of these organisms that a high-grade product can be made. This is done by keeping the sap at a low temperature, by concentrating it at the earliest practicable moment and, more than all else, by the most scrupulous attention to cleanliness in every particular The sap is gathered daily, poured into a large tank which is set upon a low sled, taken to the boiling place and drawn by gravity into the storage tank, whence it flows, also by gravity, into the evaporator, the amount being

so regulated by carefully adjusted floats as to maintain a uniform depth as shallow as is consistent with safety

The boiling place of an up-to-date plant is a substantial frame building of three rooms, exclusive of a shed for the storage of an ample supply of fuel. The main room is used for the evaporation of the sap. A smaller room is for the concentration of the syrup into the form of sugar, and the third contains the storage tanks, which of late years are of heavy tin, though formerly wood was the material exclusively used in their construction. The evaporator, of which there are many styles, consists essentially of a battery of shallow pans set upon a cast iron arch, in which a blazing fire is constantly maintained. Several of the pans have corrugated bottoms, thus exposing a greater surface to the action of the heat, and they are so arranged that the sap flows in a continuous course from one into another, constantly becoming more concentrated, being held in the last compartment until its boiling point is approximately at 219 degrees.

It is then drawn off and filtered through flannel cloths or felt strainers to remove the mineral matter held in suspension in the sap. This consists chiefly of a compound of lime with malic acid, technically, calcium malate, but locally known as "sugar sand," and also as "niter" Until very recently this has been considered as of no value, and thousands of tons in the aggregate have been thrown away Recent investigations, however, indicate that malic acid, a substance selling around $10 a pound, may be extracted at a very nominal cost, and the stuff promises to have considerable commercial value in the near future.

But the filtered syrup is placed in a deeper pan, returned to the fire, and further concentrated to the desired density If designed for maple syrup, it is standardized at a temperature of 219 degrees, making an allowance of one degree for every 500 feet of variation of altitude It is then removed from the fire, again filtered, and poured into the containers, which are then hermetically closed At the present time the gallon can, made of tin and fitted with a screw-cap, is the container most in evidence If designed for a soft sugar, the syrup is concentrated to a temperature of between 220 and 234 degrees, as desired, the former representing an 80 and the latter an 85 per cent sugar respectively And a temperature of 242 degrees indicates a 90 per cent product. This is as far as it is practicable to concentrate the syrup in the thin bottomed sheet iron pans in universal use in the United States, but the Canadian maker, using thick, cast-iron kettles, is able to concentrate the product to a water content of only 5 per cent

The cost of an equipment for operating a maple sugar-making plant is about one dollar per tree, exclusive of the boiling house, which may be as elaborate and expensive as one may please. The labor cost of collecting and concentrating the sap varies greatly, but it is generally assumed that one man and team can gather and attend to the boiling of the yield of 500 trees. Under the most favorable conditions he may be able to do much more, and under unfavorable conditions he may not be able to do nearly as much During the past few years many maple sugar makers have installed systems of spouts which take the sap either directly from the tree or from convenient stations and convey it by gravity to the storage tanks, thus largely reducing the labor cost. The only other cost is that of fuel This, of course, varies according to local conditions, but it is calculated that one cord of good wood, rightly handled, is sufficient to concentrate a sufficient quantity of sap to make 1000 pounds of sugar

On account of the cost of production and the comparatively limited quantity which it is possible to produce, maple sugar can never compete with cane or beet sugar for general purposes. But as an auxiliary to supply the table with a most delicious syrup, and also for use as a confection, it is playing its part to the limit in conserving other forms of sugar.

Our Reserves of Energy

(Continued from page 183)

The upper atmosphere contains enormous stores of electrical energy which are continuously being regenerated by solar radiation, winds and other influences. No doubt the day will come when great towers will be erected for tapping this vast supply The chief difficulty in the way now is that the atmosphere, even when damp, is so poor a conductor that a single tower can tap only an insignificant portion of the field. The presence of a small amount of radium, however, makes the air a conductor of electricity for a considerable distance around it. And it is very likely that we shall one day find a much cheaper means than this for rendering the air a conductor, so that towers built a considerable distance apart can tap large fields of atmospheric electricity

There are still other promising methods of developing the sun's heat. A pet dream of the writer has been the conversion of sun's heat direct into electrical current by the use of the thermal couple When a schoolboy, he constructed an apparatus consisting of a number of thermal couples connected in series so that by burning a candle or even a match he was able to develop a small continuous current of about a volt for experimental purposes. There is nothing against applying the same principle to the generation of the sun's heat except the large initial cost of plant involved It is not unlikely that this difficulty will some time be obviated.

We need never fear exhaustion of fuel, for it will never come. We will slowly cease using it and begin using other sources of power as economic considerations dictate But it will be a development so gradual that we will not be conscious of it It is beginning even today

The Inventor and the Gay Gambler

(Continued from page 151)

"This machine can be played with a soft flannel shirt. It is absolutely noiseless, no complicated parts and nothing to get out of order It is the only machine on which there are no strings or rubber bands. We make this machine to operate with either a knee-spread or a straight leg movement, as preferred" etc

The central mechanical contrivance of all these affairs is a fine folding and extending device of some kind, varying greatly according to the make of the holdout Some of these extending devices are like the folding steel lazy tongs used on telephones at office desks. Others work on the pneumatic principle, the arm being extended down by a pressure of air What hasn't been devised today will be in the market tomorrow The variety never is exhausted The inventor never tires.

We come now to that other celebrated instrument of gaming, the roulette wheel made famous by Monte Carlo. It has often been said that this is one of the fairest games for the amateur, and this may be true enough if the wheel be operated as at the famous Monaco resort. There the roulette wheel contains the usual thirty six numbers and a single "green" or zero A dollar bet on any number pays thirty five for one, the bettor receiving his dollar back, of course. So, if you bet on a number the bank has thirty five other numbers and the zero against you The percentage of the bank is thus one out of thirty six. When roulette was adapted for American use, however, another "green," the double zero was added, "for the police payoff," as a famous gambler once told me Since the rate of payment on our wheels is the same as abroad, 35 for 1, this change has simply meant an additional chance against the player In Europe he is payed 35 to 1 for playing 1 to 36. Here he gets the same pay for playing 1 to 37 The gambler's percentage is thereby doubled Instead of being a little more than three per cent it becomes about six and one-half This alone is a ruinous handicap for the player, but nothing of that kind satisfies the gamekeeper as we know him today With all due respect to the fraternity, the only absolutely "straight" wheel now operating to my knowledge is at Monte Carlo I do not know personally about Cuba, but what reports have come my way are not reassuring

The roulette wheel came into America about thirty five years ago. Since that time inventors have constantly improved on the methods used for its corruption One early and obvious contrivance was a little mechanism which applied a brake, first to the rim and later to the axle of the wheel The wheel was allowed to run until it had almost lost its momentum. Then the croupier or an assistant leaned against a lever which applied a brake just after the heavily played numbers had passed the ball. The wheel came to a stop and the ball naturally fell into the pocket corresponding to a table-number which was being played lightly or not at all.

Next came the knockoff or mule's ear, a small sliver, neatly cut out of the track in which the ball revolves about the numbered wheel, which is rotating in the opposite direction and so affixed to a button that it

can be pushed out at the right moment to trip the ball and cause it to fall into a pocket in that quarter of the wheel where no heavy bets lie. This was soon afterward improved by changing the mule's ear to a fine needle, which jumped out in the same way when the croupier chose to stop the ball and cause it to fall where no big losses impended

Another inventor soon devised a wheel for those roulette devotees who like to play red and black at even money In this machine the partitions between the alternate red and black pockets of the wheel were raised and depressed in turn The croupier, if he saw that red was being heavily played, took the ball and spun it to the right with his left hand Almost invariably the ball fell into a black pocket. If the big bets lay on the black, he spun it to the left with the right hand The raised and lowered partitions did the rest—the ball fell red It was a good trick unless someone discovered that the ball was not always being spun in the same direction.

Soon came a more brilliant adapter than all these, with a roulette wheel made up of two pieces, an inner saucer and an outer movable rim but so cleverly fitted together that no eye could discover the joining What happened? If I played a stack of chips on 18 and the ball actually fell into that socket, the croupier instantly touched a lever and the inner saucer moved over one space, leaving the ball reposing in 31 or 6, the neighbors of 18 on the wheel This beautiful atrocity also had its day and went its way

Electricity, of course, was not slow to be applied to the roulette wheel Here again we have the electro-magnet controlling a ball with a steel core, as in the dice game on the showcase The magnet was placed under the wheel at a certain place, controlling an area of perhaps ten numbers, whichever spaces happened to be passing over it at the time the switch was connected. The croupier began turning the wheels and spinning the little ball with the steel heart. As long as all went well there was no cheating, but as soon as some player got to winning consistently, the dealer watched the numbers on which the chips were piling up. Now, as the wheel spun around, slowing toward the stop, the croupier waited until a quarter of the wheel passed over the magnet. Instantly he stepped on the switch and the ball dropped into a losing slot—losing for the player Such wheels are still in common use wherever the fair lady Fortune is allowed to spread her perilous skirts.

The many cheats at roulette, all of them dependent upon a visible control of the ball or the wheel by the croupier, led to a demand for a covered wheel. The theory was that if the wheel were concealed after once the ball had been spun, so that neither the player nor the croupier could see what was going on until after the ball had come to rest and the lid been lifted, it would be quite impossible to commit such gross frauds against the infatuated player As a result, covered wheels were immediately provided, both fair and foul.

On one of these pages you will find photographs of such a covered roulette wheel. In playing, the cover is not placed in position until the bets are laid on the cloth or table. When all bets are down, the croupier carefully places the lid in position and spins the ball or marble in the funnel at the top of the lid The ball soon drops down through the neck of the funnel and, still spinning, passes through one of the holes in the under side of the lid, which you may observe in the raised cover When the players have heard the ball fall into its pocket, the croupier raises the lid and—lo! not a man has won a bet.

The reason for this ill luck (Sic) is not far to seek From the neck of the funnel a concealed tube or track runs to one of the openings in the lower face of the double cover In some of the best machines this tube is a coil, so that the innocents may appear to hear the ball rolling about inside the lid. But whatever the arrangement, the ball always makes its exit from just one hole. This winning hole is situated at the point marked on the cover by the screw-head with the vertical slit, directly facing the reader in the illustration. The gamekeeper simply waits till all the bets are down and then places that screw-head directly over a number on which there are no bets. Inevitably, he wins and you lose. If you ask him to put the lid on before you lay your bets, you are but little better off. He sets his lid so that the exit hole rests on one of the partitions between two numbers. When the ball falls it does not enter a pocket but is held up against this partition It can now be turned into the pocket at the left or the right by a slight twist of the lid in lifting. The croupier naturally turns the lid in such manner that the ball falls into the numbered pocket that profits the players little or not at all.

The gambler-inventor is still at it. This is what he has done to date. Tomorrow's marvels may be more deeply desolating. Moral Barnum was right.

Doing Away with Dots and Dashes

(*Continued from page 183*)

on an antenna current varying from zero to hundreds of amperes. Thereby, to employ a picturesque phrase of the Signal Corps, the ether of space is bombarded with a mass of frequencies never twice alike in the same letter"

A gain of more than 150 per cent in the speed of the transmission of telegraphic signals is claimed in behalf of the sending of the Morse alphabet or code by the radical method outlined In fact, the outstanding advantage of revision of the International Morse alphabet appears to be its accomplishment of facilitating a dispatch of a maximum volume of telegraphic traffic with the use of a minimum number of signals. The Signal Corps has sketched a graph indicating the relative speeds of the International Morse alphabet, the Morse alphabet, and the newly proposed system of transmission This exhibit, while showing an increase of 150 per cent by the use of the latter method, does not completely measure the advantage in this particular The existing Morse cable alphabet involves the sending of some of the letters by adjacent signals of the same sign, although the signals occupy equal periods of time. For instance, in letters such as "a" or "l," three or four signals have the same sign. The alphabet proposed by the Signal Corps indicates that no two consecutive signals shall duplicate the same sign thus, for the first time a continuous wave of one definite frequency is used for the alphabet. Such an arrangement permits of the utilization of electrical and mechanical tuning, either or both.

A chart drawn by the Signal Corps illustrates the method of modulating a single frequency wave, the principle involved in the proposal of dispensing with the time element in the sending of code and distinguishing the *dots*, *dashes*, and *spaces* by the varying intensity of the signals. It is arbitrarily decreed that the largest amplitude represents a dash, the median amplitude a dot, and the smaller or zero amplitude is reserved for representation of the space necessary in the transmission of the telegraphic code. This method has been practically demonstrated by engineers in both the United States and England. The principle involved in this system of sending code renders it possible to modulate a single radio frequency by a number of modulating frequencies, and thereby multiply the capacity of each radio frequency channel.

This revolutionary theory with reference to a revision of the mode of transmitting the International Morse alphabet likewise contemplates a reduction of "static" or atmospheric disturbances, the constant bane of radio reception during the summer months. In this system of transmission very low modulating frequencies are employed, and according to the Signal Corps, it would seem relatively easy to devise instruments that shall be selective as between the low modulating frequencies and the higher frequencies of atmospheric and other natural disturbances. A chart prepared by the Signal Corps shows that a modulating frequency as low as ten cycles per second, which is considered a very high frequency for ocean cable practice, corresponds to 75 words a minute. This by far exceeds any form of sound reception. A modulating frequency of 60 cycles a second, the normal power frequency, corresponds to a speed of 450 words a minute, with five letters to the word.

If traffic dictates a reduction of this speed, according to this system of sending code, this may be accomplished by making the same perforations in the tape of the transmitting apparatus correspond to a suitable even multiple of a semi-cycle. To illustrate, by making each of the signalling units correspond to six complete cycles of current, instead of one semi-cycle, the rate of sending radio signals is curtailed to 37½ words a minute. This approximates the speed of commercial traffic. Thus, it is seen in this new method of sending the telegraphic alphabet, wave trains or frequencies are used as the elements for signalling.

Steel carries the load here

The busiest men know that loose leaf ring books can carry a good part of the burden of "keeping track of things" And because of the constant use their ring books get, these men want a device that will not break down under the strain of hard wear

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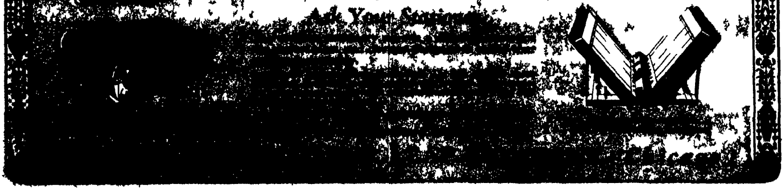

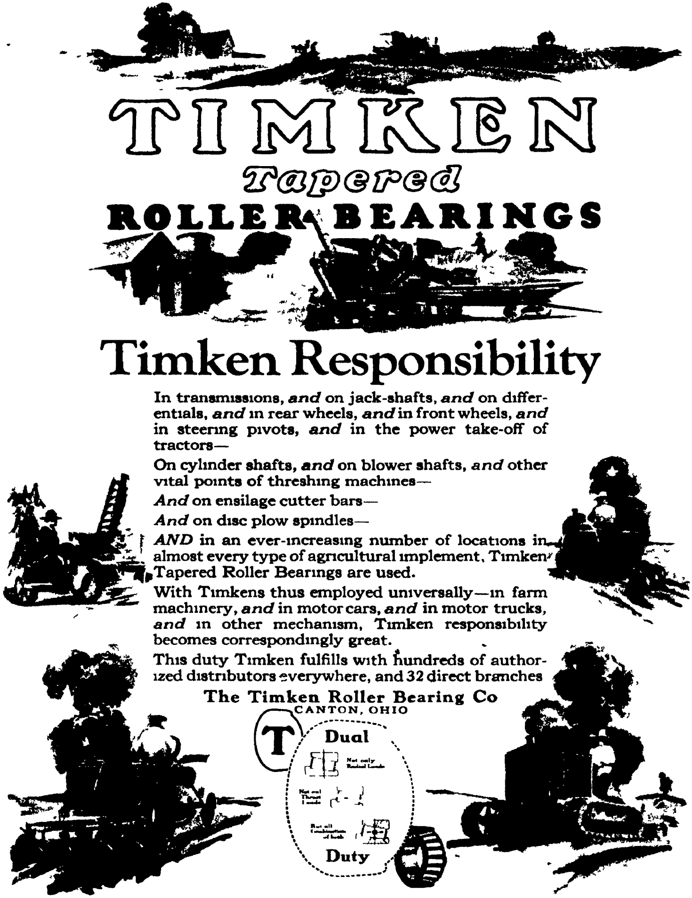
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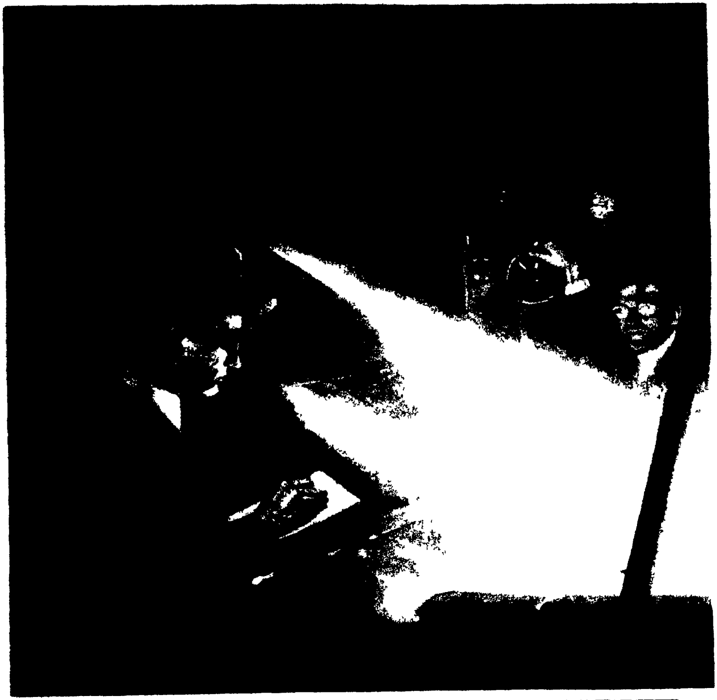

WHERE FIRE RESISTANT ROOFING SHINGLES MUST MAKE GOOD THEIR CLAIM—[See page 234]

Scientific American Publishing Co., Munn & Co., New York


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THE SCIENTIFIC AMERICAN, October, 1923 Volume 129 Number 4 Published monthly by Scientific American Publishing Company at 233 Broadway New York, N Y and printed in the U S. A. Subscription price, $4 00 per year Entered as second-class matter June 18, 1879, at the post office at New York, N Y, under the act of March 3, 1879.

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by

J. G. CHAPLINE
President
LaSalle Extension University

What does the future hold for you?

What do you *want* it to hold? And—what are you doing Today to put into your Tomorrows the things you want to find there?

That is the question—and it's self-answering.

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Money is only the symbol—*Time* is the universal medium of value.

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Invest your Time—work—prepare—constantly increase your ability to render Intelligent Service—and your Future becomes as certain as human destiny can be.

Hesitation—procrastination—inaction—the thought without the deed—are the universal enemies of mankind.

But they have yet to conquer any man who *really* fights.

J. G. Chapline

Interesting Facts About LaSalle

LaSalle Extension University was founded in 1908. Its first course was in Law, and the method it employed was so different from the old-time correspondence methods that it immediately won the endorsement of many of the leading jurists and legislators in America. "I had served three terms in Congress and had gray hair before I took up the fascinating study of the LaSalle Law Course. I speak from personal experience when I say that LaSalle has reduced the correspondence system of education to a science"—this the testimony of J. Adam Bede, distinguished lecturer and for many years Congressman from Minnesota.

Today, LaSalle Extension University, thru its seventeen courses, offers training for every important business need.

With financial resources of $7,500,000, with educational and administrative staffs numbering 1600 people, with a total enrollment of over 400,000 and an annual enrollment of 60,000, LaSalle—thru its distinctive Problem Method—has added more than $250,000,000 to the annual earning power of the men it has trained.

LaSalle-trained men are occupying important positions with every large corporation, railroad and business institution in the United States.

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If someone should tell you that five years from now you would be sunning yourself on a park bench—out of work, out of luck, and convinced that you were a failure—you would probably tell him in no uncertain terms that he was a liar.

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Every few years, however, the benches are peopled with hundreds and thousands of men in exactly that predicament—and the thing that confounds one is the fact that hardly a man of the lot, five years before, would have believed it possible.

While Others Were Being Displaced This Man Won Promotion

People judge harshly when they say that the men who thus find themselves out of work are not deserving of employment.

There are no finer fellows living than the thousands of men who returned from France to find that there were not places enough to go round. Fortunately, most of these men are now at work. But there was a time—and not so long ago—when they were forced almost to beg for a place.

These men deserved employment, if ever men deserved it—but—business at that time was in such condition that only men who had PROTECTED their jobs by TRAINING—by the development of some special ability to do some special thing—were able to hold their own against depression.

During this period, when men were struggling to get on their feet once more, even LaSalle-trained men did not always have it easy. Demand even for men who have EQUIPPED themselves to perform some special work does not always equal supply.

But—make no mistake—their lot was easier BY FAR than that of the men who could offer merely WILLINGNESS TO WORK.

And in countless instances it was the LASALLE-TRAINED MAN who was retained when others were let go—and in countless instances he won promotion.

There comes to mind, for example, the experience of Sidney Litchtenstein, of Philadelphia, who in August, 1920—just as the business depression was causing many a concern to shut up shop—enrolled for LaSalle training in Modern Business Correspondence and Practice, and who, in January, 1921, after completing only eight assignments, reported a 40 per cent increase in salary—"when all other employes of the company were being discharged or receiving salary cuts."

"LaSalle," wrote Litchtenstein, "is not only a means for increased efficiency, it is insurance against hard times. As soon as I have completed my present course, you'll find me enrolled for another."

—Not particularly dramatic—Litchtenstein's experience—but it was not selected for dramatic purposes. It is merely TYPICAL.

Secure In Their Jobs and Rapidly Advancing

Times are booming now—there is plenty of work for the routine office man—and if he is content with a handful of change each week, his employer will likely enough be disposed to keep him. "All's well," says the man who has no ambition. "Perhaps a year from now, three years from now, I'll be sunning myself on a bench and twirling my thumbs—but for today and perhaps tomorrow—All's well!"

If you belong to the great army of the easy-going—and are content to STAY in those ranks—LaSalle can do very little for you.

If, on the other hand, you are in earnest to GET AHEAD—you will find encouragement in such statements as the following—from LaSalle-trained men who are using their evening hours for advancement:

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"Words cannot express how much I appreciate your advising me of the position, which I later secured, as rate clerk for the .... Railroad. I like my work and have decided to become an expert in it, with your help; and am expecting to go on up into the bigger and more responsible positions with the railroads."
A. H. WALTON, Georgia.

"Passed the Arizona bar examination last week at the head of a class of seventeen, including graduates from some of the best-known resident law schools in the country. I certainly do appreciate what you have done for me, and realize better than ever the excellence of the LaSalle course and the methods of teaching you employ."
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"Your course in Modern Salesmanship has given me many ideas and plans of action, methods of finding the market for merchandise, making the most of an article's selling points, and approaching the prospective buyer, and has helped me wonderfully in that hardest part of a salesman's job, namely, closing the deal. With my course less than half completed I can emphatically say that the knowledge derived therefrom, if measured in dollars and cents, would exceed $1,000."
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"When I enrolled for your Business Management course I was just plugging along with an ordinary bookkeeper's job, but today I am proud to say that I am out of that rut and have full charge of all the work in the office. Very often I am left to manage the entire business, and I have also been awarded an increase in salary which up to this time is over 400 per cent."
J. GLENN HOBBS, Georgia.

What Will YOU Write Home to the Folks?

What does the future hold for YOU?

Will you write back home, "I've just had a 'raise'—I'm head of my department now"—or—"I had hard luck last week; I've got to look for another job"?

There's a little coupon just below this text which has guided many a man into secure and profitable positions.

The man who is sincere in his desire to increase his earning power will do well to mark and sign and mail the coupon NOW.

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Upon request, the book "Ten Years' Promotion in One," and material completely descriptive of the course and service that interests you, will gladly be sent without cost or obligation. Indicate your choice by checking, and write below your name and address.

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With the Editors

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October, 1923

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN, President ORSON D MUNN, Treasurer

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Vol. 129 No. 4. Published monthly Entered as second class matter, June 13, 1879, at the post office at New York, N Y, under the Act of March 3, 1879

Price, 35 cents a copy $4.00 a year Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5 00 a year, postage prepaid.

ONE of the things which we have learned to look for in Monday morning's news sheet is the catalog of the motor fatalities of the week-end And the one fact which we cannot escape as we read over this long roll, is that a majority of the wrecks were caused by bad driving or bad equipment. Sometimes the guilty party suffers, sometimes the victim is the innocent bystander who was blinded by another's headlights, struck when an other's brakes failed to hold, or crowded off the road by another's hoggish tactics. But whatever the circumstances and whoever the sufferer, the accident that is truly an "act of God" in the sense that it was not to be anticipated and avoided, is rare.

THE percentage of car-owners who are criminally reckless in their driving or in their care of a car is no larger than it has always been—we suspect that it is even less. But in aggregate numbers, the spread of the automobile causes this class to be ever increasing—faster than they kill themselves off, unfortunately, and as the congestion of our roads grows ever greater, the probability is constantly larger that a car which gets away from its driver will find another fellow to smash up.

THE condition must be faced, and the remedy sought. Traditionally, the American is prone to adjust his troubles by passing a flock of new laws, so it is not to be anticipated that we shall come through the present crisis without the usual flood of suggested new legislation—some of it doubtless well considered, but most of it, half-baked or even rawer than that But whether the cure lies in new enactments, in different administration of those we have, or in some other direction quite unconnected with the law, it must be found.

AS our own contribution to the discussion and to the search for a cure, we are going to seek out the opinions of a quantity of people who are in positions where they must necessarily have formed opinions. We shall draw upon all available sources for viewpoints and for facts. The result will be presented on these pages. Whether it will take the form of interviews, of contributed articles, or of editorial compilations of numerous opinions upon given phases of the subject, we cannot at the moment say We have sent out "questionnaires" on similarly timely topics before, and perhaps we shall do so again. In any event, however we handle it, this contribution to the clarification of the automobile problem will be one of the features of our coming issues.

THERE is a legend, among printers, having to do with the setting of type for a new edition of the Bible. The publisher planned to make this volume mechanically perfect, free from every last typographical error Proof was read by six different people. Then a reward was offered all employes for any surviving misprint turned up—first a shilling, later actually a pound. And, after all this, the volume was printed with a dozen blunders of composition—which were promptly called to the editor's attention by readers.

THE genus reader can always be depended upon for this. Some of them are sarcastic, some contemptuous, some in search of a job, some abusive—and some, of course, animated entirely by the sincere desire to be of help. Publisher and author and editor are always glad to have the typographical error brought to their attention They would be better pleased if the average reader were sufficiently aware of the nature of the case to realize that a small residuum of such error is unavoidable, but that is probably too much to ask

IN our own case, the ordinary hazards of human fallibility are further complicated The final reading given our articles in this office is ordinarily by the member of the staff who actually wrote or edited the thing in the first place Under these conditions, it is even easier than usual to slip past a wrong letter or a wrong word. One knows what one wrote, and in spite of everything one's eye will be guided by this knowledge and read the text as it ought to be *rather than as it is.* Thus it is that we make Professor Russell give the Einstein deflection of light as 1 75 inches and 1 75 minutes, in the same article, instead of 1 75 seconds, thus it is that we do most of the other things that look so foolish in black and white

THE psychic investigation goes on apace, and will have its due share of our space for many months to come After a lull following the unfavorable sittings of May, we have on our hands several further mediums, with whom sittings apparently will be held in time for publication of the results in one of the two remaining issues of the year In the mean time, Mr Bird's book is now passing through the press, and there will shortly be available this much more complete account of his informal experiences than there has been space for in our columns From the beginning of his European trip this volume had been in mind and he accordingly sent home, for abstraction for the paper and filing against his return, the most detailed accounts of all his sittings. Though his articles in the SCIENTIFIC AMERICAN have been most interesting it is quite obvious that he could not there give all details On the two Sloan seances, for instance described in some 4000 words in our May issue he had written over 12 000 Those who feel that they are interested in the subject need not therefore refrain from reading Mr Bird's book through fear that it will too largely duplicate what they have already read in month-to-month installments.

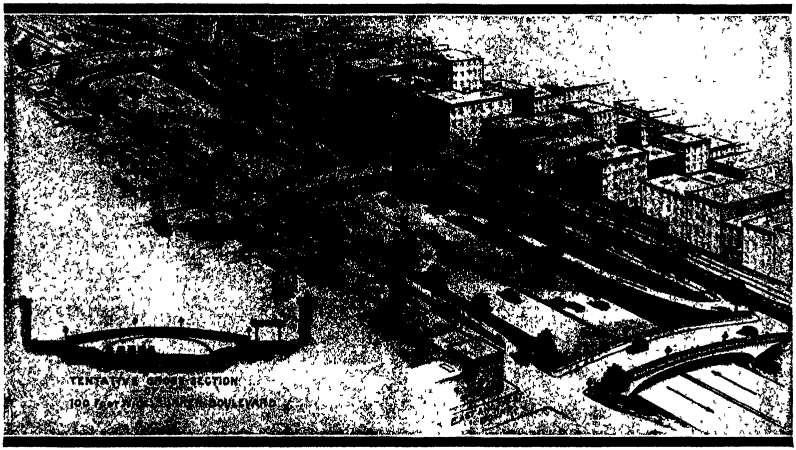
AMONG other interesting subjects scheduled for early treatment is the way the water department of a big city wages constant warfare against the billions of billions of microscopic foes in the precious fluid the development of high explosives that will not freeze, and that do not therefore have to be thawed out, with the peril that accompanies this operation, the use of compressed air in midget wind tunnels to get practically all the results that could be attained with a giant tunnel, a remarkable new speed-changing gear that works through an oil pump, without any meshing wheels the scientific study that has been made by the Federal Government of the part that distribution costs play in our economic system as contrasted with actual costs of production Mr Klemin's admirable résumé of aviation progress will be continued, the second installment having to do mainly with gliders and the correlated low power planes. A remarkable salvage undertaking upon an English cathedral which was crumbling with age will be described, and it will be told how hypodermic injections of concrete in the old walls saved the structure And so on—only there isn't any more space to tell you about our coming features.

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, OCTOBER, 1923



One way in which traffic could be made to flow smoothly through our congested cities. The suggestion is made with particular reference to New York, but is of universal applicability

A Sunken Boulevard for Automobiles

NEW YORK CITY is laid out on Manhattan Island, twelve miles long and two wide, and though the city has spilled out in all directions, its traffic problem is centered here Crosstown traffic is intrinsically large, but in comparison with the flood of vehicles moving up and down the island it shrinks into insignificance. And herein lies the one feature of New York's problem that distinguishes it from that of all other cities. To carry the small fraction of the total that moves east and west there are over 200 streets, for the enormous volume of vehicles that run parallel with the island s long dimension, there are eleven thoroughfares that start sufficiently far downtown and are not interrupted by Central Park Under no conceivable arrangement of existing facilities will there ever be other than extreme congestion.

There are two obvious measures that would bring some relief. One reason for the slow movement of traffic as a whole lies in the presence of cars, trucks, horse-drawn vehicles and trolleys, all on the same street. With one or two exceptions none of the streets is wide enough for more than two lines of traffic in each direction, and three of them suffer the further complication of being more or less obstructed with elevated pillars. Trolleys and automobiles must stop to take and discharge passengers, and even parking cannot be entirely banned. The net result is that traffic does not flow, it crawls; and the only conceivable remedy is segregation of the various classes of vehicles upon thoroughfares of their own The subway and the elevated are fast mainly because they automatically effect this segregation—they make their own pace, instead of having it made for them

The second root of traffic evil lies in the intersections of crosstown streets Crosstown traffic is not large in the aggregate, but it tends very strongly to concentrate upon a few streets—a dozen or less of these certainly carry 90 per cent of the traffic A street leading from a bridge or a ferry is peculiarly subject to this condensation of traffic And when the two streams, one running north-and-south and one east and west meet—well all the traffic towers and traffic officers in the world could not maintain a smooth flow Ultimately the grade-crossing must be eliminated where two main arteries of automobile traffic meet

Schemes are ever being put forward for relieving New York s traffic jam, and when one is found that is successful it will be of country wide interest and will be universally copied. For the suggestion illustrated on this page Mr Cameron Clark is responsible

Mr Clark would plant a sunken boulevard, 100 feet wide, in the center of Manhattan Island and running substantially its entire length. This would give space for four lines of traffic in each direction, with an extra line on each side for stalled cars. Where the capacity of Fifth Avenue is but 3000 vehicles an hour, and that of Park Avenue at the Grand Central viaduct only 1000 such a thoroughfare would accommodate 18,000 per hour Crosstown traffic would bridge the boulevard, and sluggish vehicles would be excluded, hence the speed safely attainable by the boulevard traffic would be greatly increased

Access to the boulevard would be by single-track inclined ways, that would slip down the embankment at the side From every alternate cross street these would run in either direction to meet the boulevard. The one would be for entrance to the thoroughfare, the other for exit therefrom, as indicated by the arrows on our drawing There would then be no turning whatever on the boulevard itself traffic would flow in and out on gently converging lines, with no confusion Further clarity would be obtained by a pronounced obstruction in the middle between the north-bound and the south-bound thoroughfares. A driver wishing to turn and go back would have to run up one of the approaches, cross the bridge and run down on the other side, putting the inconvenience of his maneuver upon his own shoulders, instead of compelling approaching drivers from both directions to modify their pace for him

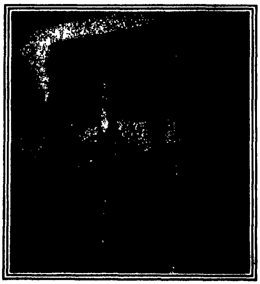
Mr Clark would locate this boulevard on Second Avenue, and he would carry it across Canal Street and back uptown on the west side to connect with Riverside Drive Real estate values along such a location would be moderate, excess condemnation might pay for the whole project.

Protecting Our Great Banks

Armor of Concrete and Steel that Aims to Foil the Scientific Cracksman

By Edward H. Smith

ON A memorable Monday morning in 1878—October 28, to be precise—the cashier of the old Manhattan Savings Institution turned his key in the lock of the street door, walked nonchalantly into the banking room and fainted. Men will do stranger things in the face of miracles, and one had been wrought here. The door of the great iron vault gaped open, torn and twisted on its hinges, as though a Titan had wrenched it with the weight of mountains and the power of tides. On the floor was a litter of papers, account books, coins, pieces of shattered iron and ends of broken tools. From the interior of the huge metal box long considered beyond the strength and ingenuity of men, was missing a total of $2,747,700 in cash and bonds. The greatest bank robbery in our history had been committed between Saturday night and that sickly dawn.



Huge rectangular plug door closed, showing the massive hinges and the exterior mechanism

The cashier revived, summoned the other officers in haste, closed the doors and put up a sign relating that the bank had been forced to suspend because of robbery. Policemen came in droves, crowds gathered and tried to storm the entrance, the news spread through the city and across the country, runs on other banks began and were checked with difficulty. The corner of Broadway and Bleecker Street, where the bank stood, was obstructed for many days with crowds of curious people who had come to see where this astounding thing had taken place. The doings of a small gang of cracksmen became a piece of history.

To this burglary, just forty five years ago, is to be traced the beginning of modern developments in the protection of our great banks against criminal attack, so it may be worth while to glance at some of the facts concerning it.

A gang of notorious professional bank burglars, headed by the famous Jimmie Hope, had laid plans for the attack on the Manhattan Savings Institution and consumed all of three years in working out their scheme. They had eventually corrupted one Michael Shevelin, the bank watchman, gained entrance to the place with his collusion and worked on the vault door with wedges, powerful jackscrews and explosives, through the nights of Saturday and Sunday, finally reaching the bonds and cash at about 3 30 o'clock on Monday morning. Their loot consisted of $2,506,700 in registered bonds, $73,000 in coupon bonds and a fortune in cash. To save the bank from disaster and foil the robbers, the Congress and the State Legislature passed acts cancelling the stolen registered bonds and causing fresh securities to be engraved and issued in their stead. To such lengths the nation had to go to protect its finances against a few bold and clever men.

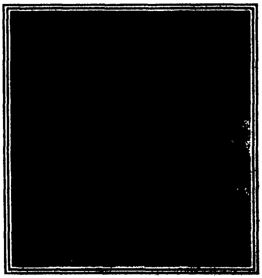
It must not be assumed that such a burglarious raid as that on the Manhattan Savings Institution had happened without precedent or that the banks had not done what they could to prepare for such attacks. The burglary of large banks was an old story in 1878, and great quantities of inventive energy and of bank money had then already been expended in the quest of some method of vault construction that could be relied upon. It is interesting to note some of the ideas then applied.

The vault of the old National Park Bank, when it was finally dismantled some years ago, to make room for a modern substitute, was found to have been built of solid slabs of granite, closely fitted together. The edges of each such slab had been incised with a series of hemispherical depressions, which fitted precisely to similar scoopings from the adjoining granite blocks, thus forming globular holes, five or six inches in diameter. Into each of these holes a cannon ball had been placed, so that if a burglar tried to enter the vault by digging at the joints of the stones, he would encounter the loose cast iron balls.

Another vault, of a slightly later period, had been formed, inside a construction of solid masonry, of two plates of cast iron, each about one and one-half inches thick. The inner face of each of these plates had similarly been cut with innumerable hemispherical depressions which fitted against other such cuttings in the opposing plate. Into the spherical holes thus formed had been placed large numbers of chilled cast iron balls, like large ball bearings. The notion was that these loose balls would deflect the drill of any burglar attempting to make his way into the vault. It must be remembered that nitro-glycerine was then unknown and that the burglar had to drill holes to get at the tumblers of the locks or to blow in the gunpowder which was then his only explosive agent.

But all such precautions were not of much avail, for the reason that the better bank burglars of the day understood how to attack the strongest vault doors then in existence. Invention had provided nothing better than heavy, close-fitting doors of cast iron, chilled and later case hardened, but iron doors, after all. We shall have a word to say about the evolution of the vault door. For the present it is enough to observe how burglars, without such weapons as they now possess, ripped their way through the no doubt formidable defenses of the old banks.

Another New York City feat of the same Jimmie Hope will illuminate the matter. In the fall of 1868, Hope rented a basement under the rooms of the Ocean National Bank at the corner of Fulton and Greenwich Streets and opened a carpet business. In front was his show room, in the rear his work room. To divide these and keep customers and passersby from intruding on his privacy, he had a partition erected, dividing the two parts of his establishment. In reality this ceiling high screen was put in place to mask his operations against the bank, whose vault he had carefully studied.



A 30-inch thick block of steelcrete (concrete and steel) after a laboratory attack lasting only a few minutes, made with modern tools

On the night of June 27, 1869, nine years before his greater feat at the Manhattan bank, Hope and several assistants, including the famous old robbers Ned Lyons, Mark Shinburn and George Bliss, reached the banking rooms by means of a hole they had been slowly cutting through the ceiling of their carpet store and the floor of the bank. They went to work on the door of the vault with wedges. First a fine wedge, no thicker than the blade of a knife, was hammered into the crack of the door near the lock. A slightly thicker wedge was next pounded into place with sledges, and then a still heavier tool took its place. Gradually the burglars worked their way up to wedges two or more inches thick at the base. These were forced home with big jackscrews, which got their purchase from heavy iron bands or cables which had been passed around the vault or secured to its back by heavy hooks. Gradually the jacks were turned until the thick wedges forced their way in and pried the door from its iron jam. The bolts were now forced back and the work was done. Explosives and heavy crowbars were then used on the inner iron door. This robbery totaled $1,200,000, of which, fortunately, the larger part was in non-negotiable bonds.

As a consequence of this mode of attack, the construction of doors came to be the matter of chief concern with the vault builder. The first heavy doors in use had been straight edged, like the end of a square-sawed board. Then, in order to get a door that would close more tightly, came the bevelled or sloping edge, the inner face of the door being narrower than the outer. But the wedges of the burglars soon put this pleasant scheme to rout. Then came the stepped edge which is still in use on all ordinary office safes. The steps were designed to stop the wedges from penetrating beyond an inch or two. Wedges backed by powder formed the burglar's answer to this scheme. Then came the tongue-and-groove edge, which did good service until nitro-glycerine came along. The grooves now proved to be a happy circumstance for the cracksman. His liquid explosive lodged in them and he got wonderful results from a minimum of "soup." Faced with this peril, the vault builders went back to a battleship or armor-plate door, which was soon found worthless.

To day, in the best modern vaults, only one type of door is employed, the so-called plug door, shaped exactly like the cork of a medicine bottle, with smooth edges, no steps or grooves and slightly smaller in diameter inside than out. Such doors vary in thickness from two to five feet. They may be either round or rectangular and they weigh as high as a hundred tons! Laboratory experiments have shown that the plug door gives the maximum of resistance to nitro-glycerine. If a quantity of this explosive is forced into the crack at the door jam and detonated, the main force of the explosive will spurt into the vault and out into the room, because the edge of the door is perfectly smooth, giving the explosive no purchase.

The construction of such doors is one of the marvels of modern vault engineering. Entirely aside from its complicated multiple time-locks, its numerous powerful bolts, its intricate inner locking devices and its other mechanical intricacies, such a door is a first-class piece of engineering. It seems to the eye to be a solid piece, yet it consists of many layers, it is a composite in more than one sense. The layers, to mention only some of them, are ordinary strain resisting steel, reinforced concrete, used against fire, heat resisting metal, to delay burglars operating with the cutter-burner torch, tool resisting metals; at least one and often two layers containing the wires and foils of electric burglar alarm systems, and so on.

Such tremendous doors are in use by some of the Federal Reserve Banks, notably in Philadelphia and Cleveland, by J. P Morgan and Company and others. The Morgan door weighs about 50 tons and that of the Cleveland Federal Reserve Bank, the thickest if not the largest ever built, is said by its makers to achieve a total weight of almost two hundred thousand pounds.

But when we have glanced at these surprising facts and figures, the real wonder of the modern bank vault has only been hinted. It is a maxim with the builders of these strong rooms that a vault is, like a chain, as dependable as its weakest link or part. Thus the floor and sides of the vault must be capable of offering the same amount of resistance as these tremendous doors.

They must be designed to foil any possible or conceivable method of assault. In addition, they must be constructed to resist fire and the tremendous heat likely to be developed when a great building comes into conflagration In consideration of this risk, the roofs or tops of the big vaults of today must be even stronger than the floor, sides and front or door, for the roof must be additionally reinforced against the impact of falling bodies from above, in case of the collapse of a building through fire or earthquake

What kind of engineering is required for the achievement of such prodigious strengths may be guessed when the dimensions of the really big bank vaults are understood. For instance, in the new Federal Reserve Bank in New York there are three such vaults, one on top of the other Each vault measures about 125 feet in depth and about 55 feet in average width The bottom of the nethermost room rests on bedrock and the walls of the vaults are in part under the waters of the harbor The main door of each of these vaults weighs about 90 tons and each of the three rooms has a second or emergency door, used for ventilation during business hours. The weight of each main door with its vestibules is in excess of 300 tons and the materials composing them are those already listed, tool resisting metals, steel, acetylene torch resisting metals, reinforced concrete, cables, alarm wires and the like The vault doors of this bank are not of the plug type an other and unique design having been employed to suit the needs of the building in which the vaults were placed.

In describing the structure of the walls, floor and roofs of our great vaults, it is to be remembered that no standard has yet been arrived at, that a number of engineers entertain conflicting ideas about certain details of construction and that experiment is constantly being carried forward. Again, the chief difficulty in arriving at a perfected type of vault, and one that is not likely to be overcome in the future, is the matter of the constant development of tools useful in attacks on such constructions. Some months ago, in articles devoted to the struggle between the burglar and the maker of safes for small banks, I accentuated the fact that a race, like that between the gun maker and the builder of battleship armor, is in progress and has been for at least two generations. The same thing is true of the great bank vault There has not been a successful burglary committed upon the vault of any great metropolitan bank in this country since 1878. Nevertheless, industry and the arts have gone ahead and perfected a number of tools which might at any time be employed by burglars of sufficient skill and daring to seize the opportunity To this class belong the electric arc, the electric and pneumatic chisel, the electric drill and the oxy-acetylene torch in its latest development.

This last named tool is of especial peril and interest I have previously written of its effectiveness against the safes and vaults employed in rural or suburban banks and the defeats met by manufacturers of strong boxes for this clientele. It now appears that the cutter-burner tool, as it is preferably called by vault engineers, is a decided menace even to the great banks and their ponderous equipment, so that much reconstruction and endless experiments are in progress. To date nothing has been found that can be called a genuinely effective resistant

The effort to find metals which would foil the withering flame of the torch is not without its note of romance When the oxy-acetylene cutter-burner was first employed there was a great scamper after heat resisting metals and a number of compositions were produced which withstood the fiery tongue of the torch fairly well (I mean to say compositions sufficiently low in cost to be commercially useful) When these discoveries were made the vault and safe building world breathed easier again, but only for a short space Then the inventors of the torch discovered that they could add immensely to the cutting and fusing power of their tool by using the so-called fluxing rod Their purpose was, of course, to extend the industrial use of the torch, but what they turned out proved to be a most formidable burglarious tool

The fluxing rod is a stick of soft steel. When the flame of the torch is applied to any metal for the purpose of cutting and melting, the end of the steel rod is placed at the tip of the flame and against the metal to be cut The very rapid oxidation of the soft steel rod raises the normal temperatures produced by the torch to enormous levels and the additional excoriating effect of the iron oxide enables the operator of this device to cut and burn his way with tremendous rapidity through any material or combination of materials now known to practical use The power of this tool and all the others must be taken into consideration when a vault is designed

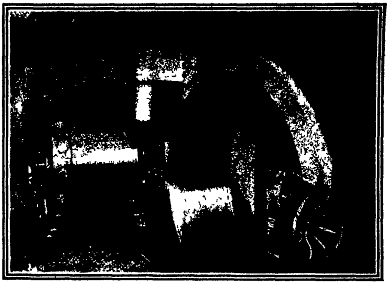
When it was first realized what the cutter-burner and rod would do to metals, many vault engineers turned their backs abruptly on everything but reinforced concrete as a proper material for vaults. Consequently some vaults were built in which this material alone was relied on, walls of extraordinary thickness being laid in the hope that they would foil the burglar or hold him in check for days. Here, again, a considerable blunder was made for, while reinforced concrete does give a maximum resistance to the torch it is comparatively frail in the face of explosives and the high power tools which the highest type of burglar might command under special circumstances All this was brought out by laboratory experiment and especially by a series of tests made under the auspices of the Federal government at its artillery proving grounds two or three years ago All kinds of vault materials and constructions were then placed under every imaginable form of strain and subjected to all manner of attacks. It was hoped to develop a material or method of construction that would resist the worst buffetings for several days. I believe I am revealing no secret in saying that nothing of the sort was found and that the maximum period of resistance achieved was not more than a few hours.

According to Mr Frederick S Holmes, the celebrated New York bank engineer, the ideal vault of today is, like the great doors, just described a composite Its walls, floor and ceiling are constructed mainly of a special type of reinforced concrete, but many other materials figure in the structure In the first place, the concrete is reinforced with such slight materials as woven cables and lengths of steel rails Again the concrete walls are full of anchors facing both outward and inward, so that if burglars should succeed in cutting a plug out of one of these thick walls, they would be unable either to push the plug ahead of them into the vault or pull it out toward them They would be forced to break it up into small chunks and thus gradually make an aperture large enough to admit them In addition, the best wall, floor and ceiling construction of vaults now calls for both linings and interlinings of various metals, very much like those employed in the great doors.

To make his way through such a lined, interlined, reinforced and anchored wall of concrete, usually from two to three feet thick, the burglar would need, first of all, to break away the outer layers of concrete with tools and explosives. He would then encounter the metal interlining, which he would be forced to attack with the torch and rod This done, he would again face great thicknesses of concrete, filled with reinforcing cables, rails and rods. Then he must again encounter a layer of various metals which would once more call for the torch And, last but by no means least, he must have encountered the wires and cables of the alarm system before he had got well under way The vault builder, however builds independently of the alarm. He builds a wall capable of turning back a burglar even if the alarm does not function

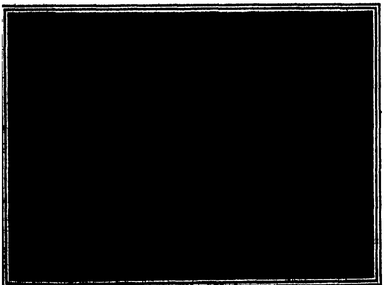
All this being understood, it must still be admitted that even vault walls of such monumental strength and intricate design might be breached in a few hours by burglars having the maximum of technical knowledge, the fullest equipment of the best tools, the best

(Continued on page 293)



Fifty-ton plug door of the vault in one of our great private banking houses. The floor is removable The door is 36 inches thick

Ready to pour a great vault for a Federal Reserve Bank. Note the reinforcement rods for concrete interlaced with the cables for burglar alarm system



Telltale switchboard in the watch captain's room of the U. S. Treasury at Washington, D. C., which indicates operation of doors, time locks, and so on

Some Curious Comestibles

Amazing Articles of Food that May be Unearthed in Odd Corners of American Cities

By L. Lodian

A grotesque food from the rivers of Manchuria—big dried shrimps, strung on bamboo spits

ONE of the oddest looking of imported food stuffs in daily use among the exotics of American cities is the big dried shrimp from the rivers of Manchuria These creatures are spitted on split bamboo—always a sign of oriental handling and on soaking and steaming they enlarge visibly Their food value is not high, as with a good many other delicacies, imported or domestic Still there might be the germ of an idea in this method of preserving for the American fish trade For example, the Far East usually preserves without salt, by just sun-drying the goods. A Westerner would be likely to insist that it can't be done but the flowery republic has been doing it successfully since the days of Confucius—and beyond Salting they reason, has more demerits than merits. Salt attracts moisture and increases weight, causes the agony of thirst in parched climates, is destructive of some of the nutritive elements in food, and does not even completely prevent the development of bacterial life Complete saltless desiccation largely overcomes these disadvantages Once dry and kept dry, there can be no putrefaction

Automobile tourists who go in for concentrated provisions might find useful the compressed rice-macaroni blocks imported from the trans-Pacific republic Its advantage over the rice grain is its rapid cooking, brought to a boil it is ready in five minutes. And there is no danger of burning as there is with the straight grain if not watched

This vermicelli like rice product swells in boiling to about four times its dry diameter, when the threads become of beautiful pearly transparency, and print can be read through one True, it requires a certain amount of practice in mouth gymnastics to negotiate these long elusive strings—but this is a source of actual fun to the novice

Lovers of horse flesh—gastronomically that is to say, not sportively can obtain pure all horse viands in more than a dozen different preserved forms, also, the fresh article I have handy a few price lists of retail horse butchers the items read temptingly enough, if prejudice can but be overcome Horse meat is remarkably fat free one not "in the know" could not tell the difference between it and Chicago's finest

The flattened and compressed jaeger smoked and dried sausage is the most concentrated of all these rolls of mystery It keeps well for years owing to its dryness it can be carried loose in the pocket It is eaten as it is, or steamed, the latter is better It is called jaeger from the rural guards of the Central European States, who are wont to carry it as a sustaining emergency food. It may be ranked as one of the most fortifying elements of nutrition in a condensed state extant.

The eating of horse meat is standard in the German republics, in the Italian peninsula, in the Flemish countries, in France—and, surreptitiously, everywhere else Quantities of delectable gelatin are imported into New York from Delft, in the Netherlands, which is famed for this product Those tempting, tremulous colored jellies and blanc-manges made with it are almost exclusively derived in the first instance from the well stewed viscera of "ol' hoss." There is a daily procession into the outskirts of Delft, representing a round up of played-out work horses from neighboring States, especially the British Isles. Of course, all disease germs are steam-sterilized to destruction.

What look provokingly like dried oxtails are the strings of "mel'bi" (untranslatable) from Araby the blest Walnut kernels are halved, threaded with slim cord, then dipped into a batter paste made of wheat flour mixed with palm or date—or, in the Nile region, the local imfi—syrup. The whole, after repeated dipping, is simply sun-dried to the proper degree.

FROM the huge sea slug of the Orient, pictured in all his repulsiveness projecting his bulk into the upper corner of this box, through all the other items which he illustrates and describes, down to the jaeger sausage of horsemeat that drapes its graceful shape across the adjoining lower corner, Mr Lodian tells us only of foreign foods that he has sampled, both in their native surroundings and as domesticated, more or less, by the American dealer who caters to the tastes of our foreign colonies. We think he makes his story quite as interesting as his revelations of what the other half eats usually are — THE EDITOR.

This singular looking nut-and-fruit juice cake is always obtainable among the Arabic-speaking colonies of urban communities in the United States. It is a choice morsel, the nut imparting part of its delicate flavor to its protecting succulent covering It is dry to handle, having been floured in the non adhesive rice flour which, unlike wheat flour, becomes glutinous only by heating with moisture.

The well-nigh complete cessation of strife in the Turkish states is reflected in the return to American markets of much Near-East foodstuffs. The peculiar little one-pound rose-colored sugar canes of the harem (refined palm sugar with rose fragrance) affected by the fair inmates of the seraglio for their tiny cups of coffee or tea—this is perhaps the daintiest sugar reaching our shores. It has the inconvenience of having to be broken into pieces with a sharp rap from the sugar tongs, to procure a fragment as required for use.

Those goat-skin containers full-up—apparently—of squashed or flattened-out yellow "bananas" are a mystery The outsider would never take them to be the real tid-bit Turkish kabjar or caviar The fish roe is cured whole and solid, then steeped in beeswax, hence the color and honeyed fragrance of the article.

The Paris biscuit-charbon (charcoal biscuit) has been known these two centuries or more, yet has only been imported to America the past half-dozen decades. It is not a medicated article any more than a whole-wheat biscuit would be so considered, but is a regular food product It tastes just like the plain unsweetened wheat biscuit The color is an intense jet black—one-third vegetable-charcoal flour to two-thirds whole-wheat flour The color density of charcoal is such that it does not take much to swamp whatever shade may be associated with it.

Brillat de Savarin, the brainy jurist and gastronomist of the early nineteenth century, author of "The Physiology of the Sense of Taste," which is translated into many languages, has written that it is never well to let others know what you have been eating, through the vehicle of breath odors, "whether vinous, or as a whiff of oranges," and he instances the usefulness in this connection of a couple of charcoal biscuits with a glass of water after meals.

But that is only one use. British medicos indicate their use in acidity conditions, in preventing belching, that disagreeable reminder of one's dinner, in forestalling the beery breath of the noble Briton, also as a vermifuge and a slight aperitif In this form, as food and corrective combined, the charcoal biscuits continue to live their usefulness through the ages, and the marvel is that they are not made by American bakers. Decade after decade, the local importers of fine groceries have had to order them from Gallic and British makers, with serious delay in delivery Many products instanced in this series of illustrated articles on the more featureful foodstuffs of the alien colonies of America could be produced in our own factories, hence it is hoped that the descriptions will have a commercial value, as well as an interesting theme

Take, for instance, the rose-flower marmalades. There are two kinds, the Turks use the choice Damascus white rose, the Orientals the large red rose corresponding to our American beauty The vehicle of preservation may be virgin honey, common in China, or the date or palm or imfi syrups in vogue from the Bosporus to the Nile delta. All this import of the luscious and fragrant rose marmalades could be duplicated by American preserve manufacturers and our florists, who annually have in the aggregate tons of raw petals that go to waste from day-old stocks, could thus dispose of their discards.

The fragrance of the rose marmalade is not that of the freshly plucked rose, but resembles more the modified fragrance from a blossom a day or two old." It comes in sealed containers or crocks holding approximately five pounds, which on opening are found to be

sometimes little more than two-thirds full This is due to the contents' having been steam sterilized in vacuo at a minimum of heat, after the sealing of the container, it is purposely never filled, so as to allow for heat-expansion of the contents and thus prevent fracture of the container. Also, the rose fragrance is thus retained in almost all its exquisiteness. For pastry, tarts, etc., the rose confection is added cold at table, opening beforehand would dissipate the fragrance. The container itself figures at table until used up.

The unique nut peach of mid Asiatic countries was illustrated on these pages (December 13, 1919). A western peach-growing specialist obtained specimens of the fruit, planted some of the stones, and now reports that the plants are growing vigorously. In a few years we may expect to see the made-in America nut peach on our markets. This is a freestone peach, always to be preferred to the clingstone variety with a smooth skin like that of an apple or plum, a sweet almond like edible kernel, and an exquisite aroma which renders it for fruity fragrance, different from any other peach in the world. A whiff from a freshly opened crate is a precious memory! From fruit stores specializing in foreign products, this peach is always obtainable in season.

This time we illustrate another fruit marvel of the central Asiatic lands—the stone-hard syrupless sugar-date. This is odorless, non-sticky, yet glossy. It can be carried loose in the pocket. It has, like our rock candy, only an intensely sweet taste. The sugar crystallizes right inside the fruit on maturity, we show one halved, revealing the white sugar granules. This is the only known fruit that can be used, direct, as a sweetener. The effect is the same as though one used ordinary refined sugar, there is no fruity or syrupy taste imparted to the drink, only the diffusion is slower, and the tough date must be broken in two to facilitate matters.

Not dried ox-tails, candied walnuts from Turkey

This wild growing date is, unfortunately, one of the tenacious clingstone variety. The pits are sharply pointed on either end and are used by the natives as small dowels or nails. The slit that forms so prominent a feature of the outside contour of the ordinary date-stone is not observable, it occurs only as an almost negligible cavity in the *center* of the slim pit, containing the filament-like germ.

These dates are crushed by the ton in the countries of origin, on maturity, the liquor is sun-dried in hollow pans to a hard cake (there is no invert-sugar to care for) forming the cheap *gur* date-sugar of Oriental markets, as Cairo, Suez, Singapore, Calicut, and scores of other eastern sugar emporiums. These lands have a diversity of sugars quite beyond the experience of the occidental user of cane and beet sugar. In fact, the annual production of sugars other than the beet and cane variety is greatly in excess of the tonnage of these super-civilized varieties, being computed at more than *20 million metric tons.* One of the big sugar head quarters in Wall Street has a permanent exhibit of these other-world sugars.

The wild dates are always obtainable at Oriental importers in the prominent American cities. They can be grown in our southwestern States, and have the double ability that they can be sold as fruit fresh or dried, or as a direct sweetener. I first came across them north of Tashkent a quarter of a century ago, but they are not known to American date specialists, and even the Foreign Plants Section of the Department of Agriculture never heard of them.

The tropical American cone sugar illustrated—just the succulent pan-evaporated muscabedo—retails today in the Latin American bazars at five cents per kilogram (2.1 pounds), which is certainly below the cost of sugar in our own markets. This rough, dark brown product is esteemed by the South Americans for use in their strong coffee. It imparts a delectable smooth savor which refined sugar does not give.

The refined white-sugar cones of the Central European republics are kept out by the tariff with its American valuation, in spite of the favorable exchange. In Europe this article retails at about a cent a pound.

Slugs as an article of diet do not appeal to the western world, yet the native Ethiopians relish them as a tid bit. A tree slug, corresponding in size to the common backyard slug of American garbage heaps, is chopped out of the decayed wood in which it lives, and swallowed alive and whole, with great gusto—it is considered at its best, thus. Of course, on abstract principles this is no whit more revolting than our own fashion of eating clams and oysters—it all depends upon what you are used to.

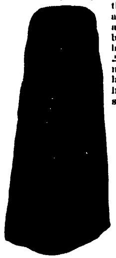
The Oriental does not bother with the small slugs, he prefers big game in this field. Sea slugs are his piece de resistance. The slug tribe is a big one. Far Eastern importers in American cities are never without a large variety of them. Sea slugs range in size from a goose-egg to those the size of your hand or even bigger. The prevailing color of the dried article, the only form in which they are met commercially, is a dingy gray. In fact, they look altogether like the little round droppings of mortar which one may often notice at the base of a brick wall going up. And they are just as hard! Yet soaked and steamed, they go over into a delectable gelatinous mass, and make a sustaining broth that has merited their introduction into some of the Australian hospitals, as a builder up for convalescents.

One of the larger sea slugs is illustrated herewith. Dried it is the size of a plump rat; steaming about doubles its size. In its desiccated state it has a feeble gelatinous odor, not unpleasant and the color is almost black. Contrary to universal custom in eviscerating objects destined for drying for food use these sea slugs have the viscera removed through an incision running the length of the back which also enables them to be opened out quickly and sun dried. As they dry they automatically close up again leaving a visible slit. On the under side, the rudimentary feet are plainly discernible.

Bread Diseases

THERE are several changes which take place in bread which are due to the presence of micro-organisms, and which may accordingly be called bread diseases.

The first of these converts the bread to such a condition that it can be pulled out into threads. This bread disease is most common. The crumb becomes sticky and colored. *The most characteristic symptom is that* the bread, on being broken, can be pulled out into fine threads. The bread assumes quite a disagreeable odor and taste. The musty acid odor can be detected in bakeries, where the disease has been prevalent, many weeks after it was first noticed. The particular bacteria which bring about this disease belong to the potato bacilli group and possess one characteristic in common, that they produce spores which are extremely resistant, being able to withstand the heat of the baking oven. The bacteria grow best at a temperature of 20 to 28 degrees Centigrade. The formation of the sticky mass in the bread, which can be pulled out into long threads, is due to the swelling of the bacteria membranes.



Crude-sugar cone of Latin American markets

Bread becomes bloody-colored due to another bacillus. Outwardly, the appearance of the bread is the same, but when it is cut open red streaks are seen in the crumb. This disease and the one described previously are most troublesome to the baker, because once the disease sets in, it is an extremely difficult matter to eradicate it. The utmost cleanliness must be observed to prevent the occurrence of these diseases and to destroy them once they do set in.

Bread also has a tendency to become moldy for it is a first rate medium for the development and growth of molds. Various molds can produce various colors in the bread. For example, the mold mucor produces a white coloration, aspergillus glaucus a bluish green coloration, etc. Reddish and black spots may also be produced by molds. Neither the molds themselves nor the decomposition products which are brought about by their presence in the bread are deleterious to the health but they make the bread unseemly in appearance and unpalatable.

There are various precautions to be followed in order to avoid the development of these diseases in bread. A moderately high temperature is favorable for the growth of the bacteria. Warm bread should be cooled off quickly after baking. The moisture in the bread is also of importance in this respect. Moisture promotes the growth of the bacilli, and hence a poorly baked bread in which the moisture content is high will be more apt to be attacked by the germs than a well baked bread. The air in the room in which the bread is kept must not be moist. Well baked bread, cooled as quickly as possible and kept in an airy dry and not too warm room will not be subject to these diseases. Of course, the main prerequisite is painstaking cleanliness in the baking operation and in the baking rooms.

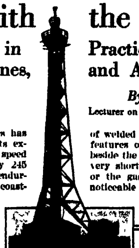
Tests of Tires Made from Reclaimed Rubber

THE Bureau of Standards has placed an order with one of the rubber companies for the making of fifty tires using various amounts of reclaimed rubber in the treads. After manufacture, these tires are to be tested in the laboratory and also on trucks of the Post Office Department over four different types of roads, so that the relative wear of the different compounds can be determined.

Left: Compressed rice-macaroni from China. *Center:* Jet black charcoal biscuits from Europe—a regular food and not a medicine. *Right:* Wild dates of the tenacious clingstone variety from mid-Asia, containing plenty of sugar but no syrup

Three more novel food products from all parts of Eurasia

With the Men Who Fly—I



Recent Achievements in Engines, Practical Aviation, Such as the Coast-to Coast Flight, Better and Arrangements for Night Flying

By Alexander Klemin

Lecturer on Aeronautics, New York University

AVIATION is forging ahead Aside from such spectacular achievements as the huge dirigibles and their mooring masts of the type here shown, as well as the tiny low-powered airplanes and gliders, there has of late been a steady succession of remarkable improvements and developments in flying craft We have asked Mr Alexander Klemin, the well-known authority on aviation, to review for us the outstanding developments in the aeronautical world, and the accompanying article is the result Because of its length we have found it necessary to publish this article in two parts The second part will appear in our November issue —THE EDITOR

RECENT progress in aeronautics has been almost bewildering in its extent and variety The world's speed record now stands at nearly 245 miles per hour Awe-inspiring endurance records and a non-stop coast-to-coast flight are likewise to the credit of the American Army Air Service Engines on full power tests are now expected to run 250 hours continuously Gliders remain aloft for many hours with nothing but air currents and the skill of pilots to sustain them Helicopters have risen vertically, hovered over a given point, made complete circuits in horizontal flight Airplanes have been attached to dirigibles while both types of aircraft were in rapid flight Metal is displacing wood in the construction of airplanes. Pilotless planes carry out complicated evolutions. The science of aerodynamics has progressed to the actual calculation of the lifting capacity of cambered wing sections, and its art to the design of thick, high lift wings providing relatively immense depths of structure for sustaining loads, while maintaining all the efficiency of the thin wings we have been accustomed to thus far Flaps at the rear edge, as well as ingeniously devised slots in wings have almost doubled their lifting capacity, thus facilitating slow landings.

But out of all this activity a number of things emerge very definitely and three unmistakable lines of achievement in practical aviation appear before us.

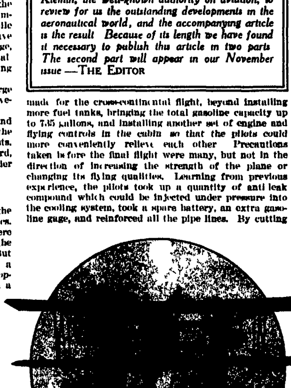
First, the enormous increase in the endurance and reliability of both planes and motors, as shown by the coast-to-coast flight and by recent Navy engine tests. Next the very rapid approach of night flying Third, the advent of the glider, of which the motorized glider or low powered airplane is the direct sequel

The Coast-to-Coast Flight and its Lessons

The coast-to-coast flight is undoubtedly one of the most dramatic achievements of modern aeronautics. The interest and enthusiasm which it aroused were country wide, and almost as great as that following the famous flight of the "NC-4" across the Atlantic But this flight has far more practical significance than a mere stunt or record It is a landmark in the development of plane reliability and marks the last act in a a real chronology of achievement

On October 5 and 6, 1922, Lieutenants John A Macready and Oakley G Kelly, of the Army Air Service, flying over Rockwell Field San Diego, Calif, in a Fokker "F IV" plane (termed the "T 2" by the Army), equipped with the famous Liberty motor, established an endurance record of 35 hours and 18 minutes continuous flight On November 3 and 4 the same men in the same plane flew from Rockwell Field, crossed the Rockies in spite of violent storms and came down at Schoen Field, Fort Benjamin Harrison Ind, after covering an airline distance of approximately 2060 miles, in a non stop flight of 27 hours 56 minutes. Their failure to reach the Atlantic was due to a leaky radiator, which such emergency measures as pouring coffee soup and condensed milk into the water system could not remedy Early in April of the same year, the same persistent pilots beat their own endurance records by flying over McCook Field Dayton, Ohio, for 36 hours 50 minutes, when they were forced to land by a cracked water jacket

They then devoted their energies in preparation for a second attempt to make a non-stop cross-continent flight, backed by the skilled efforts of Army engineers and mechanics, taking every precaution both as regards plane and motor The now historic "F-4" is worth careful study It is a huge cantilever monoplane of 940 square feet of wing area The wing sits right on top of the fuselage and nothing remains of the numerous struts and wires which are generally associated with the trussing of an airplane wing The wing tapers in thickness and plan form from root to tip so that it has a maximum strength near the fuselage where also the maximum bending loads must be met Its outer covering is of very thin veneer, most skilfully applied, instead of the usual linen The body or fuselage is made up of welded steel tubing One of the most noteworthy features of the plane is that the pilot sits right beside the engine All the engine controls are thus very short, and the slightest defect in the engine or the gas, oil or water systems is immediately noticeable Although the machine was originally designed to carry a pilot and eight passengers, very few alterations were made for the cross-continental flight, beyond installing more fuel tanks, bringing the total gasoline capacity up to 735 gallons, and installing another set of engine and flying controls in the cabin so that the pilots could more conveniently relieve each other Precautions taken before the final flight were many, but not in the direction of increasing the strength of the plane or changing its flying qualities. Learning from previous experience, the pilots took up a quantity of anti leak compound which could be injected under pressure into the cooling system, took a spare battery, an extra gasoline gage, and reinforced all the pipe lines. By cutting



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Diminutive seaplane constructed by the Cox-Klemin organization for use as a scout with submarines. Measures 18 feet over all, and weighs 630 pounds

out the cabin door and converting it into a sliding one, they gave the man in the cabin the possibility of sticking out almost his entire body into the air for inspection purposes.

The maximum speed of this plane on official Army tests is 110 miles per hour The airplane is often accused of being uneconomical, of consuming great power and vast quantities of gasoline to carry very little besides pilot and fuel. But the "F-4," weighing 5100 pounds empty, carries a useful load of 3500 pounds and provides for a flight range of six hours, carrying over 2000 pounds of what commercial aviators call "pay load"—mail, passengers or freight—which, considering the enormous speeds relative to all other methods of transportation, is not negligible. When fully loaded with its 735 gallons of gasoline for the coast-to-coast flight, the machine weighed a few hundred pounds above five tons.

Leaving Roosevelt Field, L. I., on May 2 at noon, Macready and Kelly reached Rockwell Field, San Diego, on the following afternoon after a non-stop flight of 26 hours 50 minutes, and covering an airline distance of 2600 miles. According to the pilots' own estimates the average speed maintained was 98½ miles and the Liberty motor functioned steadily at 90 per cent of its full 400 horsepower

In the initial stages of the flight the plane was greatly overloaded, and an altitude of only 1500 feet could be maintained over Long Island, New York City and New Jersey, although it remained under perfect control. At the end of the first half hour, the battery regulator gave trouble and only half an hour's hard work by Kelly saved the trip from failure in its initial stages. Reaching Indianapolis, darkness overtook the flyers, and then, between Indianapolis and Tucumcari graveyard in New Mexico, they flew by compass alone. Trying to get their exact bearings in northern Arizona, they flew low and had the most exciting time of what they called a humdrum flight. They passed over ravines, forests and canyons, and in spite of treacherous air currents they negotiated a path between the walls of one deep canyon They welcomed the hangars of Rockwell Field with relief, nevertheless, and came down in perfect condition, although neither flyer had slept during the entire trip. The man who was not actually at the wheel always found plenty to do in watching gages and instruments, and in keeping the log The sole effect of the tremendous physical effort involved was a little difficulty in hearing induced by the steady roar of the motor People had lined the whole route, Pittsburgh, Dayton, Indianapolis, Tucumcari and Wickenburg, Arizona, being the main points passed on a remarkably correct course. One hundred thousand people welcomed the pilots at San Diego, and telegrams, including one from President Harding, poured in with congratulations.

The lessons of the flight are most important. Apparently the airplane is now ready for commercial air transportation In all this arduous work, under all sorts of flying conditions, in emergency landings, the "F-4" showed no signs whatsoever of structural weakness, lack of control or instability Given pilots experienced in cross-country work, there seem to be no insuperable difficulties in navigation, whether by day or by night—although the pilots state they would have welcomed signs marking towns and other landmarks, particularly by night The economics of the airplane are not so disappointing, and it is evident that a commercial plane can be overloaded to a large extent without serious consequences—a very important factor.

Extraordinary Advances in Engine Endurance

Analyzing the difficulties experienced in all of the successful efforts of these men, we see that the trouble lies in the engine, or more broadly in the power plant as a whole

It is true that the Liberty engine functions with great regularity But it did crack a water jacket. It is true that on the coast-to-coast trip, the installation stood up well. But still, engine, fuel system and water system have to be watched with minute care and apparently give all the trouble. Here seems to be the crux of the problem—greater reliability in the engine and its installation. The installation of pipe lines, the carburetor, and the ignition, all purely mechanical problems, requiring no knowledge of aerodynamics, must engage the attention of airplane designers, engine designers and inventors. A fool-proof and absolutely reliable radiator may advance practical aviation a great deal more than the most refined improvement in wing sections. But the Liberty motor was first built some six years ago, and, as the following remarks will show, engine design is advancing most rapidly from the point of view of reliability. In spite of the vastly harder usage, automobile-engine reliability is an ideal to which airplane practice should gradually converge.

It is only very rarely now that a new principle is introduced into the design of the internal combustion engine, or even a radical modification in its mechanical construction. Progress today is improvement step by step, there is continual refinement in detail, as weaknesses develop in the air or on the test block, there is better use of material; there is a more correct application of well-known mechanical principles. A surprisingly large amount of such gradual development work is being done, however, and while the power of the airplane engine is being increased for a given weight, it is, above all else, progressing in the direction of greater reliability. It might be thought at first that greater reliability and weight per horsepower are antagonistic; that to make an engine more reliable, the weight has to be increased. But the contrary is true The same changes which make the engine lighter also improve its endurance.

The general character of such changes is very simple, however important. Long crankshafts and crankcases are inherently heavy, flexible and weak Therefore the tendency is now to bring the cylinders closer together The short crankshafts and cases are stiff, light and rugged. To keep down the number of parts increases dependability The tendency now is to keep down the number of cylinders and increase the power of each, thus keeping down the number of parts and also decreasing the weight for a given power Duralumin is as strong as mild steel and only weighs one-third as much, and is therefore being largely introduced into connecting rods and pistons.

With better cooling and better design for the admission and exhaust of gas, it is possible to drive engines much faster and to use higher compression ratios. In the old Liberty motor a great source of trouble and annoyance has been in its lack of rigidity, which involved frequent water jacket failures, as in one of the Macready and Kelly flights. Standard Liberty engines used by the Navy are now built with two six-cylinder aluminum blocks, replacing the old system of twelve separate cylinders. A concrete example indicates best what real progress has been achieved in the direction of greater power for a given weight with simultaneous increase in reliability The Liberty motor weighs 830 pounds and develops 400 horsepower The Curtiss "D-12," one of the most successful engines of the day, develops between 375 and 400 horsepower and weighs only 670 pounds. A Liberty motor averages about 72 hours in the air before requiring a complete overhaul, and the Curtis "D-12" stands up to continuous 100-hour runs, without a sign of failure or deterioration

Not only is reliability of the engine important from the point of view of safety in flight, but the cost of its upkeep is perhaps one of the determining factors in the possibility of aviation on a commercial basis. It is estimated, for instance, that it takes 300 hours to overhaul a Liberty after its average run of 72 hours in the air The cost works out at $6.30 per flying hour of the engine.

Other engines recently built, and not quite so refined as regards low weight per horsepower, fortunately show even more gratifying results as regards reliability Thus all engines purchased by the Navy now have to stand an endurance test of 250 hours at full power And one particular motor has shown truly remarkable powers of endurance This is the E-4, built by the well-known Wright Aeronautical Corporation. It is an eight cylinder motor of approximately 200 horsepower, which, when tested by the Navy Department, ran continuously at full power for 578 hours. During the test, it would have covered at the usual cruising speed maintained by the Navy seaplanes a flight distance of approximately 60,000 miles, or two and a half times around the equator The usual high-grade automobile travels 6500 miles per annum. The new engine could drive such an automobile for nine years at 100 miles per hour without showing any weakness or giving any trouble.

Certainly there is every reason to be gratified by these figures. Give Macready and Kelly an engine such as this E-4, put it into a plane as reliable as the "F-4," see to it that all pipe lines and auxiliary devices of the engine function reliably, and the possibility of trouble in flight will be as remote as that of trouble on a giant trans-Atlantic liner.

Possible Use of the Diesel Principle

While engine endurance has increased by improved design along conventional lines, there is possibly a radically different direction in which airplane engines may ultimately develop. The Navy Department in the United States, and the famous inventor Dr Hugo Junkers, in Germany, are experimenting with high-speed internal-combustion engines based on the Diesel or semi Diesel principle The well-known principle of the Diesel engine is the compression of air to pressures in the neighborhood of 500 pounds per square inch, and admission of this air to the combustion chamber at the end of the compression stroke simultaneously with the injection of liquid fuel As the temperature of the mixture is in this case above the ignition temperature of the fuel no ignition system is required therefore it follows that ignition systems and complicated carburetors may readily be dispensed with Great reliability is thus secured

Nieuport-Delage racing monoplane, showing the present-day tendency to streamline every part of an airplane and to eliminate exposed guy wires and cables

The Diesel or semi Diesel engine has a combustion cycle of greater efficiency than the usual internal combustion engine, and permits the use of a heavier and less expensive fuel than gasoline However, the difficulty in applying the Diesel principle to airplane use, notwithstanding its reliability and efficiency, is the large amount of compressed air which has to be supplied to maintain the engine cycle.

This involves the use of bulky and heavy compressors Another difficulty is that the Diesel is essentially a slow engine, because the liquid fuel will not burn efficiently with a fast running engine. Accordingly, the lightest Diesel engine ever built weighs about 60 pounds per horsepower, and this is a long way from the two pounds per horsepower of the airplane engine It is possible that the semi-Diesel principle is a more promising line of attack, wherein a hot bulb placed inside the combustion chamber is used to secure combustion at lower pressures and the air is not compressed to pressures above 250 or 300 pounds per square inch so that air compression is less of a difficulty Besides the problem of bringing down the weight and increasing the speed of revolution without cutting down efficiency owing to slow combustion of the liquid fuel, there is still the difficulty in engines built on the Diesel principle, but of small power, that valves for the admission of the liquid fuel would be extremely small and likely to give trouble.

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Low-powered monoplane piloted by Georges Barbot, the French aviator, in which he won a prize of 25,000 francs for a round trip of the English Channel

Both the Navy's experiments and those of Junkers are at too early a stage for much information to be available, but the conjecture is that both lines of work are on the semi-Diesel principle, with less compressor difficulties to overcome. Many types of this principle are conceivable A combination, for instance, which readily occurs to the designer is of two firing chambers working at opposite ends of a larger space which might constitute the compressor It has also been suggested that the air might be compressed inside the combustion chamber, a hot bulb employed, and liquid fuel injected at the end of the compression stroke It is also possible that rotary air compressors revolving at very high speed might well be utilized—a principle already successfully employed in airplane practice in supercharging the engine to avoid loss of power at high altitudes.

There is no doubt that the application of this principle to the airplane engine is fraught with difficulties, but the attainment of increased reliability and efficiency, and the possibility of using cheaper fuel, are well worth while There is undoubtedly here a vast new field for invention, research and engineering skill

Progress Toward Night Flying

The most serious hindrance to the commercial utilization of the airplane has hitherto been the impossibility of flying at night It is only when the airplane can give continuous night and day service that it will surpass such means of transportation as are available in the very fast passenger and mail trains serving all the densely populated regions of the United States. So the problem of night flying is now engaging universal attention, both in Europe and the United States

Preparations are now being made on the London to-Paris route for night flying and aerial lighthouses and other illuminating devices already make the airway between Croydon, the London terminus, and Lympne, the point where flyers cross the narrow English Channel a blaze of light at night This airway has been termed the 'Regent Street of Continental Airways.'

In the United States an aerial lighthouse is in operation at Hampton Roads, Virginia, under the supervision of the Navy Department and the United States Air Mail Service of the Post Office Department is preparing for night flying to begin at about this time According to a statement by Postmaster General New, there will then be a continuous service between New York and San Francisco, which will cover the intervening 3000 miles in 28 hours. Millions of people in the Middle West will nightly witness an artificial aurora borealis, visible fully 50 miles from its source This will be created by great aerial lights at the five regular fields in Chicago, Iowa City, Omaha, North Platte and Cheyenne Smaller lights, with a visibility of only 30 miles, will be placed at emergency fields every 25 miles along the route Aviation routing beacons every three miles, as well as ground wind indicators and red lights to mark buildings and other obstacles at landing fields, complete the ground organization

A year of these extraordinarily careful preparations and the natural advantages of the very level country between Chicago and Cheyenne are expected to make this night leg of the service almost as safe as day flying Certainly, Macready and Kelly would have been thankful for even a fraction of these devices installed along the route There is no doubt that with these wonderful adjuncts, night flying is entirely practicable and will ultimately be as general as marine navigation by night If the Air Mail is successful in maintaining its night flying schedule, the feat will be one of the historic landmarks in the history of aeronautics.

It is interesting to see how all-embracing the airplane is in its calls on other branches of engineering and industry Indeed in the provision of aerial beacons and other night flying devices a new and fascinating field of illuminating engineering is rapidly developing Some of these devices merit brief description

The very large Air Mail lighthouses are somewhat different from the shore lighthouses which are used for shipping To suit the needs of pilots they will revolve their electrical lights of 600,000,000 candlepower on top of their towers, throwing a beam of light three degrees above the horizon and making three complete revolutions every minute These lights, on grounds of expense, will be operated only when planes are expected.

The somewhat smaller aerial lighthouses, to be placed every 25 miles along the route, will, on the contrary operate continuously They are constructed on different principles. They have been developed by an American company which is a unit of an international corpora-

(Continued on page 294)

Our Point of View

The Return of the Apprentice

ALTHOUGH there is a growing doubt as to whether the good old days were quite as good as we have been taught to believe, there are undoubtedly some respects in which they surpassed the times in which we live. By way of instance, consider the day of the old apprenticeship system and the superb master workmen who grew out of it Living in the home of his employer, bound to him for a period of years, the lad commenced with the simplest elements of his trade and was required to become thoroughly efficient in one detail of his training before another could be taken up After a period of instruction, frequently lasting for seven years, he graduated as a highly accomplished workman, expert in every branch of his trade Of the ability of these workmen of medieval times we have abundant evidence in the superb masterpieces that have survived to the present day

Labor saving machinery and our modern fondness for specialization, to say nothing of the tremendous rush of modern competition, have obliterated the indentured apprentice, and with him of course has gone also the highly skilled and versatile artisan Today the ranks of so-called skilled labor are largely filled up with labor which calls itself skilled, but is altogether unskilled, and, as a direct consequence, not only does the grade of work turned out bear no comparison with that of earlier days, but the unskilled and untrained mechanics tend greatly to diminish the output and add immeasurably to its cost

Obviously, the remedy lies in the resumption as far as may be, of the best features of the old apprenticeship system, shortening the period of training and adjusting the system to the conditions of our modern industry Probably it is known to few outside the field involved, that a most earnest and successful effort is now being made in the building trades to do this very thing, and with a view to bringing this vital movement to the notice of the public Mr Grovenor Clarkson recently invited a large company of editors of this city to meet the representatives both of employers and of labor at a luncheon, and learn from them what has been done

The situation of today as outlined by Mr Burt L. Fenner, President of the Apprenticeship Commission, is that in nearly all of the skilled trades the supply of skilled mechanics has declined until there are not more than 60 per cent as many available in many trades as there were ten years ago. Some skilled mechanics, it is true come over from Europe, but for twenty five years past the number has been practically negligible Hence we must depend upon our own efforts, and educate our American boys for the skilled trades The Commission has put in operation a system which aims to give the apprentice a thorough and well rounded course of training the bulk of the instruction being given in the shop or on the job It has been arranged that while the young man is learning "how" on the job, he shall learn "why" by attending some form of training school In this respect, the Commission has met with the enthusiastic support and cooperation of the Board of Education Well-equipped classrooms and teachers have been supplied courses of study have been outlined and have been adopted, and ample funds have been provided It augurs well for the solution of this great problem, that not only the employers, but the labor organizations also are giving the new system their hearty support Incidentally, Mr Fenner drew attention to the fact, that under the present method, American boys are being brought up to better citizenship, since the seeds of radicalism and discontent can find no congenial soil among the ranks of highly successful and skilled craftsmen.

Speaking for the Chairman of the Board of Education, Mr Eugene Gibney drew attention to what he aptly called "The recent democratization of higher education" which makes possible for every citizen a high type of intellectual training The humble parent would like to see her son in the professions, yet, now that the trowel is earning more than the pen, there is a mad rush to escape the white collar brigade. So the school was called in to develop a vocational training that should turn out in a month a bricklayer or a plumber This has been regulated, and the proper balance is now being found in giving the apprentice his intellectual equipment in the classrooms, while he is acquiring experience and skill during his day's labor on the job.

Crewless Airplanes

THE crewless airplane, as its name implies, is flown without a pilot Its control, as to height and direction, is effected by means of radio impulses sent from some point outside of itself So far as its control is concerned, the machine is in the same class as the radio-controlled torpedo and it is subjected to somewhat the same limitations. It will be remembered that the earlier attempts to produce a radio-controlled torpedo called for such control to be made from the shore and, as we pointed out in those earlier days of experimentation, the range of the torpedo was limited by the range of vision and also by the fact that it would be impossible accurately to steer the torpedo if it moved very far from a straight line drawn from the observer to the target The same inherent conditions of the problem would render it difficult for an observer placed in some fixed and distant position to direct a crewless airplane against a ship at sea, or any definite object such as a machine-gun nest or a battery In fact the problem will be further complicated in the case of the airplane, by the fact that, since it is in the air and the observer on the ground, he can never be certain, as he straightens out the air plane for the final dive, that it is pointed directly at its target—consequently, it will probably strike short of or beyond the target

Hence, to direct by radio a torpedo, a crewless torpedo boat, or a crewless airplane, with sufficient accuracy to make a direct hit on a definite target, it is necessary that the radio control be exercised by a piloted airplane which flies above the torpedo, and above and behind the crewless airplane Pot-luck shooting is never profitable, that is to say it is rarely worth the expenditure of time and materials. The crewless airplane, for instance, if loaded with a heavy charge of T N T and directed from another machine, would be a deadly weapon for the destruction of bridges, ammunition dumps and a variety of other military objectives, but to send a fleet of these machines into the air, dispatch them, unattended, over the enemy terrain, and cause them to dive for the final blow, would be very haphazard work The same amount of high explosive fired from heavy artillery would, in our opinion, do much more effective work The radio-controlled torpedo is intended to be steered from the air, and we presume nothing less than this is contemplated in the use of the crewless airplane

Prevention of Automobile Accidents

A REPORT made at the last annual meeting of the National Highway Traffic Association opens with the statement that during last year 14,000 lives were lost in this country in automobile accidents. The present registration shows that there are in the United States 12,000,000 vehicles, and the manufacturers estimate that the increase this year will be 3,000,000 additional The report says that the risk to safety lies in the fact that 90 per cent of these vehicles are congested upon 10 per cent of our roads. Fourteen recommendations are made by the Committee, all designed to reduce the ghastly slaughter which is now going on, and which, unless something is done to check it, will continue to increase.

The more important recommendations come under four heads, first, to secure good designs for new roads, second, to promote adequate improvement of old roads; third, to insist upon reconstruction of existing roads at places which have proved especially dangerous, such, for instance, as grade crossings and approaches to bridges, and lastly, to improve the location of the center line on dangerous curves and elevations. Particularly urgent is the call for standard practice throughout the country in respect to the location of danger signals, the elevation and banking of curves, and the widening of the roadway with regulation of traffic on curves. On the completion of transcontinental routes there will be an increase of interstate traffic, and when a driver passes into a new section of the country, where the regulations, signal posts, etc., differ from those in his own State, he is liable, without intending it, to break local State rules, thereby becoming a danger both to himself and others. Hence, the need for standardized rules, and so far as possible, standardized constructions from one end of the country to the other

Perhaps the most important recommendations of all are those which have to do with curves on roadways and the approaches to them, and particularly the suggestion that there should be cleared away whenever possible, all stone walls, underbrush, trees, banks, etc., on the inner side of the approach, so as to make it possible to obtain a sight of the other approach at a distance from the curve of at least 500 feet Furthermore, the curves should be banked as a protection against skidding and to assist the driver in keeping within the limits of his own half of the road. It is recommended that this superelevation vary from nothing for a three-degree curve to one inch per foot of width for curves of twenty degrees or sharper Furthermore, on all curves of more than four degrees the pavement should be widened on the inside one-half foot for each one-degree increase in curvature, and the widening and banking should start at a minimum of 50 feet before reaching the beginning of the curve. Another important recommendation is that a line about four inches in width should be painted on the center line of the pavement on all curves. Furthermore, notification of all sharp and dangerous curves should be given, by sign, about 400 feet from each end Another recommendation, aimed at one of the most dangerous practices of the inexperienced or careless driver, is that the traffic code should contain a law to the effect that the attempt to pass a motor vehicle, if going in the same direction on a curve either horizontal or vertical, where the unobstructed line of vision is less than 500 feet, should be made a misdemeanor Another important provision for insuring that danger and precaution signs shall attract the eye, calls for the elimination of all advertising signs except those erected by direction or permission of the highway officials.

The adoption of these suggestions of the National Highway Traffic Association would go far to cut down the annual toll of fatalities, and we recommend them to the careful study of the various State highway officials and all owners of motor cars. They would impose no hardship on the motor-car owner, at the same time the safety of travel on our public highways would be assured.

Limit of Size of Ships

AT THE meeting of the International Navigation Congress held last month in London, there were two subjects of major importance and closely related to each other, which were dealt with in no less than seventeen reports. The two outstanding questions were the present and future size of ships and the nature and cost of the dock accommodations which must be provided for them. Any layman who may read these reports will come to the conclusion that the factor which will control the size of future ships is the rapidly growing cost of the dredged channels, piers, dry-docks, etc., which must be available for them at the ports of call.

Were it not for the difficulty, risk, and cost of handling and berthing the giant liners of today at their

Our Point of View

terminal ports, we see no reason why the dimensions of future liners should not continue to increase. Contrary to the popular impression, it is a fact that during such a busy summer season as this of 1923, ships like the "Leviathan," "Majestic" and "Aquitania," in spite of their heavy overhead charges, are able to show a satisfactory profit. The trip to Europe, despite its cost, reveals no signs of losing its popularity, for trans-Atlantic travel is growing steadily. The enormous increase in wealth due to war profits has placed the luxury of a trip to Europe and travel on the continent within the reach of a large class of people, who before the war would have looked upon it as a great extravagance. So long as there are sufficient travelers who are willing to pay from $500 to $5000 for their accommodations, big ships will be a profitable and attractive venture.

We well remember the sensation which was produced when Dr. White, the Chief Constructor of the British Navy, predicted that we should see a 1000-foot ship upon the ocean. At that time the largest vessels were the "City of Paris" and the "City of New York," each 500 feet in length. Today, in the "Leviathan" and the "Majestic," we have practically reached the 1000-foot ship, and he would be a bold prophet who affirmed that this was the absolute limit. Thus, among the papers read at the International Congress above referred to, we find that Sir Cyril Kirkpatrick, Engineer in Chief of the Port of London Authority, considers that vessels over 1000 feet will be built, and recommends that the entrance locks to the berths intended for the largest ships of the future should be 1100 feet long, 130 feet wide and 45 feet deep over the sill. He recommends the same dimensions for future dry-docks, with the floor four feet lower than the sill to permit of facilitating repairs on disabled ships. Mr. F. Wentworth Shields of the Port of Southampton stated that those who had to deal with the situation at the port frequented by the largest liners were most anxious to know whether owners and builders would eventually set afloat ships of 60,000 or 80,000 tons. According to this, and other authorities, the limit of the size of future ships should be set, not by the ship builders or owners but by the dock owners, who would demand an increased rate per ton for the dock accommodation of the larger ships. He tells us that to accommodate a ship drawing 40 feet, which is the maximum draft of the "Leviathan" and "Majestic," costs $1,000,000 per ship berth and that a berth to accommodate a ship drawing 50 feet would cost double that amount per berth. One authority at the conference stated that the cost per berth would increase as the cube of the draft of the vessel that lay alongside that berth.

Now, although it seems likely that the increase in first-class travel, and the increased capacity of such travel to pay very high prices, will favor the construction of ships of 1000 feet or over, we are firmly of the conviction that, unless some cheaper method of dock construction can be developed, the 956-foot length, 100-foot breadth, and 40-foot draft of the "Majestic" will be the limit of dimensions for future large passenger liners.

To Bridge the Golden Gate

MORE than one of the leading engineers of this country has been approached of late with the request to give a tentative estimate of the cost of building a bridge across the Golden Gate at the entrance to San Francisco harbor. In reply, they have not hesitated to state that, in spite of the great span of 4000 feet, the design and construction of such a bridge is feasible. The difficulties of the project have been those of politics and finance rather than that of engineering, but recently the California Legislature has authorized the counties to issue bonds for bridge and highway work which they may jointly wish to put through. This removes the difficulty due to the fact that the bridge would join two different counties, and now that this hindrance has been removed, a Committee has been formed for the construction of the bridge, and the city engineer has announced that a 4000-foot span will be built across the Golden Gate for $25,000,000.

As with the Hudson River Bridge, the outstanding problems are rather those of finance than of engineering. It would be quite possible to bridge this great gap between the headlands at the Golden Gate with a span that would carry any load which might be imposed, not merely by the traffic demands of the present but by the inevitable growth of traffic in the future. The limit of span for a cantilever bridge is about 2000 feet, and hence the structure would have to be of the suspension type. Now for a suspension bridge, not even 4000 feet would be the practicable limit, for the engineers who have specialized in long span suspension bridges will agree with the statement of Mr. Lindenthal that, considered merely as an engineering proposition, it would be possible, if there were a call for it, to build a suspension bridge of 5000 feet clear span, that would be perfectly stable and enduring.

The estimated cost of $25,000,000 seems low for a bridge of this magnitude, and if the city engineer has been correctly quoted, it would look as though the city were building too much for the present need and with too little regard for the growth of traffic both rail and vehicular, which the opening of this greatly needed structure is certain to promote. It is a difficult and costly undertaking to increase the capacity of a suspension bridge once it has been completed. Ambiguities will arise as to the exact distribution of the stresses between the old and the new work, and the probabilities are strong that enlargement and reconstruction will involve a sacrifice of the artistic appearance of the structure.

Anti-Railroad Propaganda

CONSPICUOUS among the great institutions and industries of the country which stand out head and shoulder above all others is our vast railroad system. Without a doubt transportation is the basis of our modern industrial life. Let us never forget that. Hence, any plot against the railroads is a plot against the country, for if the vicious propaganda, which is now being carried on against the railroads, should succeed the whole system will be threatened with disorganization and bankruptcy. If this should happen, the disaster would embrace not not only those who have invested their capital and savings in the railroads, but the great army of railroad employees and their families. Today the railroads of the country employ about 1,800,000 people, including more than 20,000 officials, and if we take the commonly accepted average of five to the family, we arrive at a total of nine million people whose wellbeing is directly tied up with the prosperity of the railroads. A large and increasing number of these employees are holders of railroad bonds and stocks, and if we add to them the millions of people outside of the railroads who have invested in railroad securities we shall find, probably, that the interests of about one-fifth of the American people are closely bound up with those of the railroads.

The propagandists of the country, headed by La Follette, are trying to spread abroad the fiction that the railroads have placed upon their properties a fictitious valuation which is about ten billion dollars greater than the exact value. The railroads are seeking to have merely a fair valuation placed upon their properties, and they ask that the Interstate Commerce Commission treat them in accordance with the terms of the Constitution as interpreted by the courts. In taking this attitude they should receive the support of the whole country. The question is not one of mere academic interest, for if La Follette and his associates have their way they will strike a blow at the railroads even more deadly than that with which they have crippled our American Merchant Marine.

There is no doubt that the railroads are today suffering from the "sins of their fathers", but the abuses of rebating, unlimited free passes, etc., have long passed away. President Roosevelt did an excellent thing, not only for his country but for the railroads themselves, when he advocated the formation of the Interstate Commerce Commission. In the earlier years of its existence, this body did very fine work; later, it began to take on something of a political color. Today, however, we believe that the Commission is sincerely wishful to give the railroads a square deal. In this effort, particularly in resisting the anti railroad propaganda above referred to, it should receive the hearty coöperation of the country acting through its accredited representatives in Congress. The situation is so serious as to call for immediate action.

How Fast Shall We Travel?

IN CONSIDERING the question as to what will be the speed of travel in the immediate future, we must remember that it is essentially one of economics, for the cost rises more rapidly than the speed, especially in ocean travel, and there is a limit to the price the public will pay. So far as ocean travel is concerned the question was answered in an article in our issue of April, 1923, by Dr. Ernst Foerster, in which he showed that to raise the speed of the "Leviathan" to 28.35 knots sea-speed would necessitate an increase of her horsepower to 185,000 horsepower, and that her length would have to be increased to about 1000 feet and her beam to 110 feet. He showed further that to secure a 33-knot vessel, the length would have to be 1120 feet, the beam 147 feet and the horsepower 380,000. Hence, it was concluded that if we wish to cross the ocean at a speed of over 25 knots, we must do so in a trans-Atlantic air liner.

With regard to travel by rail, the indications are that 60 miles an hour will be the maximum speed for many years to come. The fastest train in the world today, traveling on a regular schedule, was placed in service on July of this year on the Great Western Railway, England. The new train runs between Cheltenham and Paddington, England, and its maximum speed is obtained between Swindon and Paddington, a distance of 77¼ miles, which the timetable requires to be covered in 75 minutes, or at a speed of 61.8 miles per hour. Although this is the fastest train, there are several expresses in that country which travel at approximately the same speed over limited distances.

The railroad systems of the United States has no train scheduled to run so fast, although the speed is approached during the summer season between Camden and Atlantic City. It would be quite possible, with our more powerful engines and in spite of our heavy trains to run trains at 60 miles an hour, but of late years it has been the policy of the management to reduce the speeds of our fastest express trains. It will be remembered that, twenty years ago, the New York Central and the Pennsylvania Railroads instituted the famous 20th Century trains, which run between New York and Chicago at first in 20 hours and subsequently in 18 hours. There was a heavy penalty on these trains if they were late on arrival, and the engineers were under orders to make up any lost time as quickly as possible. This they invariably did, and some very fast running was done.

The writer traveled in the cab of the New York Central's 20th Century train for most of the distance from New York to Chicago and back, and by careful stop-watch timing, secured some remarkable records, including four successive miles in the Mohawk Valley at 83 miles an hour and considerable stretches of tangent down the Hudson River Division at a sustained speed of 75 miles an hour. On the last named run, the train left Albany 29 minutes late and in spite of numerous slowdowns made the run of 131.73 miles from Albany to Spuyten Duyvil, New York, in 131 minutes.

Our Abrams Investigation—I.

Some Preliminary Impressions Regarding the Electronic Reactions of Abrams

By the Staff

THE WORLD is face to face with a new riddle Under the name of the Electronic Reactions of Abrams, or E R A for short there has come into our midst a new method for the diagnosis and treatment of disease, which is revolutionary in its claims. Indeed on its very face this method virtually ridicules established medical science by putting diagnosis and treatment upon just as positive a basis as the measuring of an electric generator's output or the location of trouble in an electric circuit All of which is of first importance to the human race, if true, and therein lies the riddle.

The E R. A has its staunch advocates Ever since Dr Albert Abrams of San Francisco reported his discovery of certain radio-active properties of blood and worked out his revolutionary method of diagnosis and treatment, doctors from far and wide have displayed the keenest interest in the E R. A Many have gone to the Abrams clinic in San Francisco there to learn the new method from its founder Some have come away convinced, and have set up Abrams clinics in various parts of the country Others have been unconvinced from the very first. Still others have practiced the Abrams method for some time, only to repudiate it in the end And still others have started out with the original Abrams method and have then developed their own version of the electronic reactions, so that their work today cannot be considered typical of the Abrams method

The advocates of the E R. A are not wanting for arguments in substantiation of their claims They can cite case after case of remarkable diagnosis and still more remarkable cure Even the dreaded cancer has been successfully treated and cured time after time by the Abrams method, so we are assured

On the other hand Dr Abrams and his followers have by no means proved their case to the full satisfaction of the medical world, so we are told by the skeptics. Time and again, it appears, Dr Abrams has been afforded the opportunity of putting his method to a conclusive test, and he has failed to do so Investigators who have looked into his methods have as often as not made the most unfavorable reports, particularly as regards the so-called electronic apparatus of Abrams. The method has been attacked in such popular periodicals as Ford's *Dearborn Independent* and *Hearst's International Magazine* A vigorous campaign against Abrams has been conducted by the *Journal of the American Medical Association* which has been reporting the demonstrations and results of Abrams and his practitioners in a rather caustic tone

To offset the attacks of the skeptics we have the laudatory comments of prominent men and women, mostly writers and journalists—whose word means little in the realm of medicine, of course—as well as the campaign conducted by *Pearson's Magazine*, which has sufficient faith in Dr Abrams and his method to have gone to the trouble and expense of establishing an E R. A clinic in Brooklyn "This clinic has met with great success and is daily attracting many patients from all over the country who are grateful for this opportunity to become acquainted with the greatest medical discovery of the age, the Electronic Reaction of Abrams so states *Pearson's*

And there you are Both sides have now reached that unfortunate stage in a heated controversy where they ridicule each other, even abuse each other, and do not stick to cold facts and real proofs. The public is in a quandary and stands by, waiting for the final outcome

At this point the SCIENTIFIC AMERICAN, urged by the large volume of correspondence regarding the E. R. A. which has been received during the past few months, has entered the controversy not to take sides but to act as an independent investigator It is our intention to listen to the arguments of the believers and the skeptics, review alleged cases of cure as well as alleged cases of failure to cure, conduct a series of tests with the Abrams method of diagnosis and treatment, and undertake a critical examination of the apparatus employed. All the while, of course, we fully realize that the medical world and the public at large, as well as the SCIENTIFIC AMERICAN, are justified in their rôle of skeptics the burden of proof rests absolutely with Dr Abrams and his followers.

Our preliminary investigations have had to do with an electronic reactions practitioner in New York City whose work is based on the Abrams method We have witnessed and even experienced ourselves the electronic reactions method of diagnosis. To those not familiar with the general principle of this method, we may say briefly that there are two general kinds of diagnosis, one in which the patient is present in person, the other in which the patient is represented by a specimen of blood or saliva, while the reactions are obtained from a perfectly sound young man who serves as proxy, so to speak The specimen is first treated with a horseshoe magnet to "wipe out extraneous electronic emissions due to handling by persons other than the one represented by the specimen," so we are told The specimen is then placed in the Abrams "dynamizer" The latter piece of apparatus consists of electric switches with numerous switch-points, one bank of switches representing the qualitative analysis or brand of ailment and the other the quantitative analysis or degree of ailment Electronic currents are caused to flow through the coils of the "dynamizer," through an amplifying device, through the specimen, and through the healthy subject

There are various methods of detecting the electronic reactions of the human body The most common method, however, is by percussing the abdomen Percussion is to some extent a lost art, and few physicians have the necessary skill to recognize the dull area, so we are assured by Abrams advocates. The usual manner of percussing is to pass the middle finger of left hand over the abdomen, but not in actual contact. The separation is as small as possible, generally one-eighth inch All the while that finger is thumped with the middle finger of the right hand, which is provided with an ordinary celluloid thimble weighted with lead shot and wax so as to make an all but perfect contact with the end of the finger Normally, percussion indicates a region of the abdomen where dullness begins. When certain "vibrations" are permitted to flow through the "dynamizer," if present in the specimen, the region of dullness drops noticeably below normal. Then the quantitative switches are brought into play and resistance is presumably added to the electronic circuit until the area of dullness has receded to normal A reading is then taken in ohms.

If the patient is present in person, the specimen is dispensed with and the patient reacts directly to the qualitative and quantitative adjustments of the "dynamizer," which, truth to tell, is a considerably more logical procedure.

The apparatus employed fails to convince a technically inclined person. We have been privileged to take apart a typical electronic reactions machine for diagnosis, and have found a poorly wired set of coils. Instead of being in the form of true coils, the fine wire, apparently German silver or some other kind of resistance wire, is compacted into shapeless masses. The arrangement is quite simple, but we are informed that the coils have to be figured out with a great deal of care There are open stretches in the wiring arrangement, but again we are told that the circuit is an electronic circuit and not an electric circuit with which we are more conversant.

Indeed, there are many, many bizarre things about the Abrams method and its application. There are claims made for it which on their very face sound ridiculous—even the Abrams practitioners themselves admit with a smile that such claims are unbelievable until proved One which struck us particularly so is that diagnosis can be conducted with nothing more than a scrap of paper on which the patient has simply drawn a line with a lead pencil! The electronic emanations of his body mingle with the graphite and remain on the paper!

In our next issue we shall endeavor to make a formal report of an acid test of the Abrams diagnosis, undertaken in such a manner as to preclude all possibility of prior information or happy guessing.

THE SCIENTIFIC AMERICAN, fully cognizant of the vast public interest in the Electronic Reactions of Abrams method of diagnosis and treatment, has undertaken a thorough investigation of this highly controversial matter. It invites its readers to send in suggestions for tests, to give the names and addresses of Abrams clinics and practitioners, to relate their experiences with Abrams practitioners, and to give the SCIENTIFIC AMERICAN the full benefit of their knowledge of the subject.—THE EDITOR.

A Gas Mask for All Gases

IN a recent "Technical Paper, 300," by S. H. Katz, J J Bloomfield and A. C. Fieldner, of the Department of the Interior, there is described a "universal gas mask" which is considered to have the widest application of any gas mask thus far devised, and which fills every demand that may reasonably be made on a gas mask The mask is the result of experimental work performed by the Bureau of Mines at its Pittsburgh, Pa., experiment station

The army gas mask as developed during the war gave protection against all the poisonous gases, vapors and smokes encountered on the field of battle But when, after the war, army-type gas masks were advocated for use in metallurgical, chemical and other industries where noxious bases or fumes occur, the Bureau of Mines immediately pointed out that these masks give no protection against ammonia gas used in refrigerating plants, or against carbon monoxide, a constituent of blast-furnace gas, producer gas, water gas and coal gas. Recently, special gas masks having canisters containing absorbents designed for protection against ammonia or from carbon monoxide have been developed, but these afford little or no protection against other gases. To combine efficiently in one canister the absorbents for all noxious gases is difficult because the absorbents for certain gases are best when moist, whereas an absorbent or catalyst for carbon monoxide can be used only when perfectly dry Hence it becomes necessary to use dry absorbents for the other cases, and consequently to develop new absorbent for these gases which work satisfactorily in this condition.

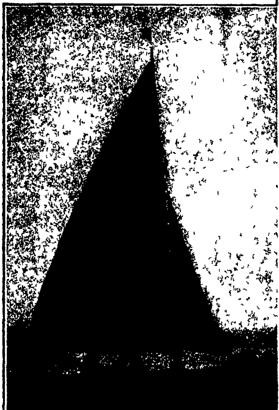
After an extended series of experiments by the Bureau of Mines the "universal" gas mask was developed. The canister contains granular absorbents, consisting of activated charcoal, for removing organic vapors, a filter of cotton wool for removing smokes, dusts and mists; caustic soda fused on pumice stone for removing acid gases, another cotton wool filter, fused calcium chloride for extracting water vapor that inhibits action of the next absorbent, "hopcalite," a mixture of oxides of manganese and copper with sometimes silver and cobalt that destroys carbon monoxide, and finally silica gel for absorbing ammonia. The complete mask and harness weigh about 8½ pounds.

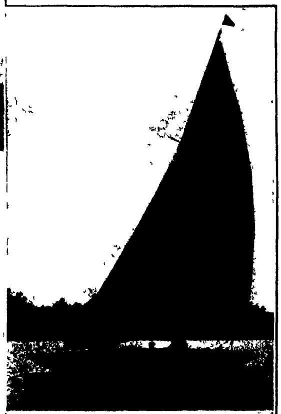
Masks of the universal type are useful for emergency purposes around chemical plants or the like in which many different gases or vapors may be met. They are especially adapted to the work of city fire fighters, who encounter all kinds of poisonous gases. However, gas masks should not be used in mines for rescue and recovery purposes after explosions, because at such times the mine atmosphere is apt to lack oxygen. Self-contained oxygen breathing apparatus which carry supplies of compressed oxygen are needed for mine rescue work. When the atmosphere contains enough oxygen to support a lamp flame the universal or the fireman's gas mask will give protection against the most gaseous hazards. Tests of the universal gas mask in actual service have totaled fourteen hours without signs of failure or serious loss of efficiency.

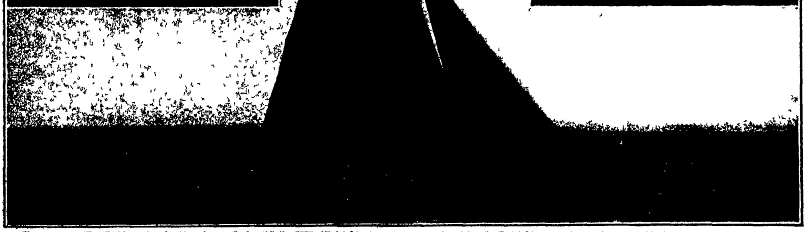
The Six-Meter International Cup Race

CLASS racing by small yachts of 20 to 30 feet waterline length is becoming increasingly popular, a fact which is full of promise for the future of this, the noblest and purest of all great sports. Time was when yacht racing, and particularly international cup racing, was of necessity a rich man's sport. In proof of this we have only to consider the great series of contests for the America's cup, when the task of designing, building, tuning up, and racing a 90-foot sloop meant the expenditure of several hundred thousand dollars. Furthermore, the sailing of a 90-footer is mainly a professional's job, with a highly paid captain at the wheel and a carefully selected crew, which in the case of one ship, the "Vigilant," came to over half a hundred men.

Contemporaneously with the development of the America cup yacht, there has been a growing appreciation of the fact that just as much skill may be developed, and competition may be every bit as keen, in the building of smaller craft that do not too seriously overtax the purse of the average citizen, and when small







Top center: "Lea" (American), 28 points. Left: "Coila III" (British), 39 points. Right: "Reg" (British), 32 points. Lower: "Clytie" (American), 27 points

boat racing began to take on an international flavor, with all the competitive instincts to which it appeals, yachting received the greatest impetus which has ever been given to it in all its long history.

Furthermore, it now became possible to dispense very largely, if not altogether, with the services of paid professional skippers and seamen, and there has been bred among us, and indeed throughout the whole yachting world, a race of amateurs who can hold their own, both at the wheel or in the handling of the sails, with the best of the professional men.

Another influence which has been most potent in the promotion of yachting was the great war, with the subsequent high rate of wages demanded by the hired hand. This, coupled with the great first cost of a yacht, has rendered it practically imperative that the owner should depend upon himself and his yachting friends for the crew

Among the many cups, National and International, which are now being raced for year by year, none has attracted so much attention, or produced such excellent competition as that between what are known as the "Six-Meter yachts." These fine little craft are designed according to a rule which absolutely shuts out any freak designing, and produces a normal boat of moderate sail spread, that is fast in any weather from the lightest wind to a breeze which calls for the tying in of reefs.

Before passing to a consideration of the races of 1923, we wish to give some facts which show how remarkable is the present revival of yachting, and to point out what a great influence the internal combustion motor has exerted in popularizing the sport Not only is the fleet of boats that are propelled entirely by internal combustion engines exceedingly large, but the sport has been greatly assisted by the practice of furnishing sailing yachts with motors of moderate power, to serve as auxiliaries in calm weather, and for service in entering and leaving harbor Thus, Lloyds Register of American Yachts for this year shows that there are today no less than 520 yacht clubs in the United States, and that in all 3000 yachts are listed for 1923 Of these about 80 per cent are either driven by engines alone, or carry engines as auxiliary power The various Meets of the present year also have shown what a great hold the sport has taken upon the American people Thus, nearly 750 vessels started in the Regatta during the recent Larchmont race week, and, judging from the number of new boats that are planned for next year, it is evident that the season of 1924 will make an even more remarkable showing

The first International contest for the cup offered for six-meter boats took place in British waters in 1921. The majority of the races were sailed under the condi-

(Continued on page 295)

Compound microscope with micrometer measuring to 0.00001 inch, used for measuring identification marks, blood corpuscles, etc.

Practical Criminology at Work

Some of the Adventures of the Scientific Modern Detective

By Norman G. Meade

FREQUENTLY a homicide case rests primarily upon the question "Was the mortal bullet fired from the defendant's gun?" For many years, in a large number of cases, conviction after conviction has occurred because the methods used to answer this question, accepted by prosecuting attorneys, the court and the jury as sufficient and convincing, have been faulty The defendant's attorney has been prevented by lack of funds or lack of knowledge from adequately examining the possibilities of error

There is a certain rigid scientific procedure which should be applied in all cases involving the question whether the mortal bullet passed through the defendant's gun All identifying marks must be observed and accurate measurement made that show the caliber of the gun and the bullet, the manufacture and the style of weapon through which the bullet was fired bearing constantly in mind that these identifying marks cannot identify individual guns that fired fatal bullets. Serious errors have been made in years gone by, through belief that identification marks that simply indicate the caliber and the manufacture point actually to the particular gun of the defendant.

One of the greatest mistakes in the past has been the assumption that a rust spot or corrosion, either in a groove or on a land in the barrel and remote from the muzzle would mark a bullet so that it would be recognized as a mark of identification on this particular weapon The marking of the bullet by pitting or corrosion within the barrel is of practically no value in determining the gun that fired it Hundreds of experiments have been made by firing bullets through new guns from the factory and the bullets have been found to be scored as much as in the case of guns with rusty or pitted barrels When five guns are selected, four of which are new and one old and rusted, and the firing test is made, it is impossible to distinguish between bullets.

Properly, the first question is whether the bullet is used in revolvers, pistols or rifles It is then possible to determine the make of the gun, pistol or revolver as the case may be. The first marks of identification are useful simply as a preliminary to the next problem The exact width of a land and a groove has been determined by proper and exact methods, but the next step is to measure all of them consecutively at the muzzle end from the right to the left around the barrel It will be found that the grooves and the lands vary measurably in width due to unavoidable inaccuracies in the manufacturing process.

The first thing, therefore, is to determine whether the mortal bullet was fired from the defendant's gun and if the marks were made by the rifling at the muzzle of his gun The measurements around the muzzle of the gun showing the width of the lands and the grooves will correspond to the marks on the bullet if it was fired from that gun The final marking of the bullet comes from the muzzle of the gun and any marks or measurements in the center of the barrel or at the breech are of no consequence in the test. Near the base of the bullet, which is last to leave the muzzle, will be found the markings corresponding to the gun from which it was fired, and these have to be measured accurately also Measurements of the gun and the bullet are made microscopically beginning from a certain point and following around the barrel at the end. A set of measurements of the bullet laid out to a large scale can be revolved on a similar set of measurements of the muzzle of the gun and if there is a variation of even one measurement, there is a suspicion that the bullet came from another gun, and if there is a variation of two or three measurements, it is almost conclusive evidence that the defendant's gun did not fire the mortal bullet

It often occurs that at the rim of the bore there is some accidental mark such as rust or a bruise which causes an elevation of the metal These muzzle conditions leave certain marks or scratches on the bullet, and if the mortal bullet corresponds to these marks, and to the measurements of the test bullets, only then was it undoubtedly fired through the same gun These are a few things to be observed and avoided, otherwise an innocent person might be unjustly convicted, due to lack of appreciation of scientific facts

Just how a criminologist goes about his work of accurately checking up the conditions surrounding a homicide case is well illustrated by the work of Albert H Hamilton, the foremost microchemical examiner and criminologist in the country, who has figured as an expert in about one hundred and sixty murder cases in all parts of the country, as well as hundreds of civil cases For example, a few years ago Elmira, N Y, had an epidemic of burglaries and the city seemed to be infested with porch climbers and keyhole artists, although there was an excellent police department The chief of police and the chief of detectives broke in upon two suspects in the room of the latter, and were killed in the resulting gun fight One officer had been shot once and the other twice A search of the neighborhood was made and a man found hiding in a cellar stairway His leg was fractured, and his .38-caliber revolver contained two unexploded and three exploded shells. Identified as one of the occupants of the murder room, he was subjected by the detective bureau to the third degree, which resulted in his giving his version of what transpired from the time the officers entered until his capture The prisoner told who carried the gun and did the shooting, which officer was shot first, the order of the shots and why the officers were unable to draw their own guns. This confession was of no value without corroboration, and the detectives waited for Hamilton's report of his findings.

In preparation for a microscopic deductive examination of the room, Hamilton supplied himself with a special microscope, measuring devices, chemicals, drafting instruments, chemical blood reagents and rubber gloves. From immediately inside of the door, he made his first general survey of every blood spot wherever located upon floor, walls or furnishings, and carefully calculated where each wound in the human body must be located to spatter the blood where found. He then reversed this preliminary process and traced the steps from where the bodies were first wounded to where the large spots showed that they finally rested

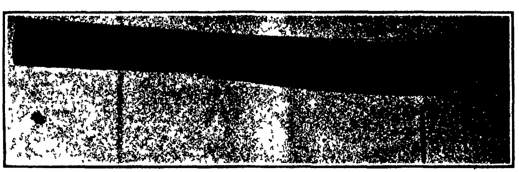
It was determined that the first shot was fired when the officers were just inside of the door, but so far there was nothing to show the order in which the shots had been fired, or which had been fired first The three bullets removed from the bodies of the slain officers at the autopsy were examined by Hamilton and found to be of three different makes. Examination of the rear of the cylinder of the mortal gun showed that the first and second cartridges exploded had contained the bullets found in the chief of detectives, and the third and last bullet had entered the body of the chief of police The first bullet wounded but did not kill the chief of detectives The chief of police had on a derby hat, and his head was held down either by himself or the burglar who was not shooting The fatal shot went through the top of his head into the brain and the officer fell, as shown by the large blood hemorrhage. In the pocket of the captured burglar there were a number of .38-caliber cartridges of two different makes which corresponded in age and appearance to those found in the revolver When Hamilton's work was completed, his report was submitted to the detective department and showed a startling corroboration of the story of the prisoner, of which he had remained in ignorance It had checked up events in the room so accurately that the prisoner was sentenced to life imprisonment

Cases frequently occur where suspicion points to a person as guilty of murder where, in reality, the slain person was killed by a self-inflicted wound. Certain definite steps are taken to prove such conditions, and may be well illustrated by a suicide case a short time ago

In a small village in eastern New York, where the principal industry is the manufacture of cotton and woolen goods, there lived a young man and his wife, to whom we will give the name of Brown. Living with the young couple was an aged uncle of Mrs. Brown, feeble and in poor health. He had no occupation, but through thrift in his earlier days had accumulated some money, which was deposited in a local bank Mr and Mrs. Brown were employed in the mills. The uncle contributed a small sum at stated intervals toward his support and was cared for tenderly by the young people.

One morning the uncle was reported as having been found shot by Brown, and Brown was reported by the neighbors as having acted suspiciously immediately before the discovery The bullet had entered the head, leaving a black mark, the revolver was found several feet from the victim's right hand Brown explained his "suspicious actions" by stating that when in the hall he heard a shot within the house which frightened him and he came out, but thought of the uncle and returned to find him dead The body was turned over to an undertaker by the coroner with instructions that it should be carefully preserved without washing or an application to any part of the body Investigation of the financial condition of the young couple and the old man showed a plausible motive for murder

The coroner, the district attorney and the county detective had been long in the service and all were experienced in the handling of suicide and homicide cases. To them the defendant's alleged "consciousness of guilt" meant danger and pos-



A murdered man had defended himself with this knife. The suspect had scars on his thigh, indicating that a knife had struck a glancing blow entering the flesh and coming out again. The lengths of the scars and the spacing between them corresponded with the shape of the point of this particular knife, as indicated in the drawing of the scars, and further demonstrated by the black marks showing these, superposed upon the knife

Checking up a weapon against the scars that it produced

sible miscarriage of justice, for innocent people often behave in the same manner as guilty ones. They knew that it was possible for a person trained and skilled in the analysis of gun-shot wounds and weapons to examine the body, the weapon, the bullet and the conditions surrounding the death of the victim and determine whether murder had been done or death was caused by the victim's own hand.

Therefore, the body was subjected to a critical examination by Hamilton, which was short, for he knew at once where to look and what to expect, no matter whether the victim committed suicide or was murdered. He first examined the wound at the entrance and discovered small grains of black gun powder in the edge of the hole in the skin. The surface showing the powder smoke deposit was less than one inch in diameter. Was it suicide or murder? It is known that in a case of suicide it is possible for a weapon to be found several feet from the hand of a victim who has fallen on the floor. The forefinger or trigger finger of the right hand was examined with the microscope and the naked eye, and the mystery was solved.

There was a deposit upon the right side of the forefinger extending about three-fourths of an inch backward and forward from the middle knuckle, made there at the instant the trigger was pulled. The thin opening between the rear of the revolver cylinder permitted the smoke from the discharged cartridge to escape and deposit on the finger. A section of skin was removed from the finger and filed with the coroner, and as this was certain evidence of suicide, it outweighed all statements of the neighbors as to the so-called consciousness of guilt which to their minds were suspicious actions.

From these cases we turn to the far West to make a comparison between primitive methods which were employed in a man hunt and the scientific methods introduced to establish the guilt of the hunted man. Our attention is directed to the sun baked elevated plains of Arizona, near the Mexican border, where there dwelt, in an adobe hut, an old *man of considerable wealth* who had the very bad habit of keeping his money in tin cans about the premises. Ultimately he was found robbed and murdered, his head crushed in by a blow, and in the bargain his throat cut with his own knife.

Rear view of the Elmira murder revolver cylinder, showing the order in which the cartridges were fired

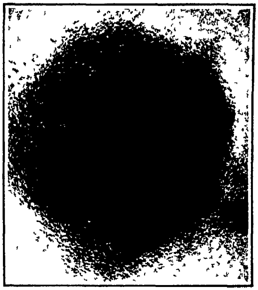
An Indian was enlisted to trail the murderer, and followed him for many miles over a complicated course. The first point of interest on the pursuit was a hut before which a fire had been built, as marked by smouldering ashes. Inside a piece of a man's undershirt was found buried, with two blood spots on it, at opposite sides, apparently over the wearer's hips. Raking over the ash pile disclosed a few pants buttons, shirt buttons, and even fragments of the shirt. The trail then led past a blood marked boulder, and finally into a half breed village and to the hut of a Mexican of good repute. Here there was found a stranger, whom the woman of the house had taken in that morning and given food. She declared in her broken English that she did not know the man nor did she have any idea where he came from. He was arrested as the murder suspect and the sheriff walked him about for a short time to enable Eagle Eye *to study the footprints. The tracks* made by the man were declared to be identical with those that had been followed for so many miles.

A casual inspection disclosed no injuries on the man's body, and his clothing was clean and without evidence of blood stains except on the thick edge of the sole of the right shoe, where there was a dark red deposit about a quarter of an inch in diameter. It appeared to the sheriff to be a blood stain, and when the Mexican was asked to explain its presence replied that he had been riding a burro and he must have pricked the animal with the stirrups, accounting for the blood on the inside of the shoe which would have been next to the animal. There was some plausibility to the story, but it was now possible to abandon the crude methods of the Indian scout, and bring modern science to bear *upon the problem. A small portion of leather contain*ing the blood stain was cut carefully from the shoe and was taken from Arizona to Auburn, N. Y. where it was submitted to an examination by Hamilton who made a chemical and microscopical analysis and reported that the stain on the shoe had been made by human blood.

At this point it will be necessary to digress from the thread of the story long enough to say that there is a simple chemical test for determining if a stain upon any object is blood, but to determine whether or not the blood is from a human being or from an animal is a more difficult problem. Blood is composed of thin colorless liquid plasma filled with red disks or cells with one white globular cell to every three or four hundred red ones. The blood is no more red than the water of a stream would be if it were filled with little red fishes. Suppose the fishes to be very small as small as a grain of sand, and crowded close together through the whole depth of the stream. Under such circumstances the water would look quite red and this is the way in which blood looks red.

The red disks or cells are so small that 3500 placed side by side, would measure only an inch and it would taken sixteen thousand laid flat*wise upon one another to make a* column of that height. Under the microscope the cells or corpuscles are found to be rounded at the edge and concave on both sides and have a tendency to collect in piles like rolls of coins. They are continually forming in the blood and as constantly dying. The size and shape vary in different animals and those of animals vary from cells of human beings, and by means of a microscopical examination it is possible to distinguish human blood from that of animals.

After the blood examination, Hamilton said that if he could go to Arizona where all of the exhibits were kept, he could, by means of his methods of examination, determine if the accused man were guilty. In the meantime, the Mexican had been indicted for murder and was awaiting trial and Hamilton went to Arizona, as he desired to do, and made some important discoveries. The shoe from which the blood stain had been removed was examined with a high power microscope when it was found that a small row of holes on the shoe cap was nearly filled with fine ashes and it had undoubtedly been used to stir the fire where the bloody clothing had been burned by the hut discovered in the *earlier part of the man hunt.*



Note the five-point-star effect, showing that the revolver had five lands and five grooves, and leading to expert identification of the make

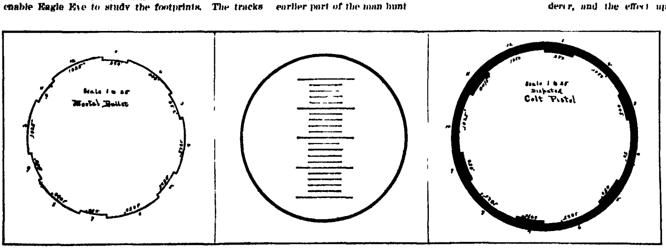
Smoke deposit from a 32-caliber revolver, black powder, muzzle one inch from the skin

The portion of the undershirt which was buried was next examined, and it was found that the blood had coagulated on the inner surface showing that it had not come from the outside and soaked through. It was therefore evident that the blood came from the person who wore the shirt. It was also evident from the location of the stains that the blood had either come from the thighs or from the crotch where it might have stained the back and the front of the shirt.

Next the body of the defendant was stripped to the knees and examined thoroughly. Upon the upper and inner surface of the thigh near the body Hamilton discovered two fresh appearing pink colored scars about an eighth of an inch wide, and parallel to each other. The upper scar was one inch in length and the lower one one and three-eighths inches long both being nearly parallel with the ground as the man stood erect. They had the appearance of completely healed knife wounds caused by a knife thrust where the knife had entered the lower wound and come out of the upper wound. It was evident that the two wounds had been made by a single knife thrust. The large bread knife found near the murdered man was examined next, and it was found that the entire blade had been more or less smeared with blood from a human being.

It was found that the taper of the knife blade was such that points on it could be found at one of which the blade was an inch and at the other an inch and three-eighths wide, and the distance between which was the same as that between the scars. That settled it. In all probability the bread knife had been held in the right hand of the murdered man as he lay back on the bed and he had struck upward at the body of the murderer and the blade had entered the left leg. In such a position the knife thrust would have passed through the overalls and under the shirt of the murderer, and the effect upon his clothes and his skin would have been exactly that observed.

At the murderer's trial the findings of Hamilton were given to the jury. The defendant on the stand claimed that the scars were made by being gored by a vicious goat when he was a boy but every juror, all ranchmen, knew that the narrow scars were made by some instrument similar to a bread knife. The conviction was secured on the showing of the bread knife and the scars. It was never known how much gold the Mexican secured as several thousand dollars in gold coins were found buried in cans beneath an arbor adjoining the victim's hut. The murderer was sentenced to life imprisonment.



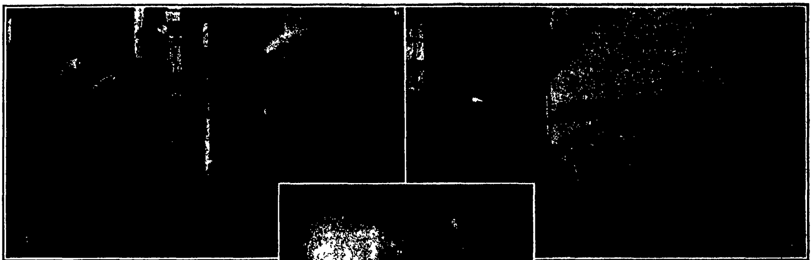
Left: Cross-section of a murder bullet, magnified 25 diameters, with actual dimensions marked of the grooves and lands. It was claimed that the bullet was fired through the Colt pistol, whose muzzle dimensions are shown at the right. *Center:* Microscope micrometer scale used in making delicate measurements. *Right:* Cross-section of the disputed pistol, showing, by divergence from the marks on the bullet, that the latter could not have been fired from this weapon

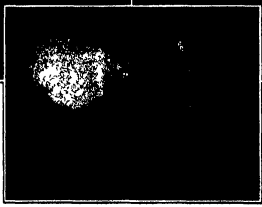
The role of the microscope in establishing guilt and innocence

Behind the Underwriters' Label

The Gruelling Tests Imposed by the Insurance Man Upon Materials and Appliances

By A. G. Ingalls





1 Turning a fire hose upon a metal window-casing just out of the furnace, to test its fire-resistant qualities. 2: Examining automobile headlight for its anti-glare properties. 3: Trying out a motor-driven oil burner to determine whether it is sufficiently fool-proof to remove the probability of its being tampered with by the user

Three widely different tests whose successful passage means lower insurance rates to the user of the equipment in question

WHEN we read that a manufactured product has been "approved" by the Underwriters, what is the reaction that takes place in our mind? Obviously, the phrase has a favorable significance else the manufacturers would not include it in the description of his product If we are the average human being, busy with troubles of our own, the chances are that somewhere in a remote corner of our mind we may have a hazy idea that the phrase indicates that the object is fireproof Maybe the manufacturer, when he got around to it, sent a sample of his product to the Underwriters, and the latter, turning it over in their hands a moment and sizing it up said it looked as if it wouldn't burn very easily and so wrote back that as far as they were concerned he could use their label and approval if they wanted to

But it isn't done that way

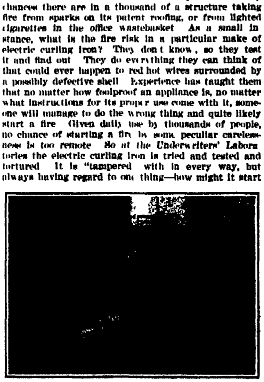
The way it is done, which is the gist of this story, is the best sort of proof that to have earned the right to bear the words, "Underwriters Laboratories—Inspected," a product must have passed through an inquisition, figuratively and literally of fire and water When the Underwriters have finished testing an appliance, or a new kind of roofing, or of flooring, or anything else and have approved it—if they have approved it—it is a safe bet that it not only involves a low fire risk, but is from every ordinary angle a good and dependable piece of merchandise

How they do go at the job is ably and interestingly told in a work entitled, "A Symbol of Safety, by Harry Chase Brearley, who begins at the beginning and tells how the whole work of inspection as now practiced grew out of an idea in the mind of one man thirty years ago It was in 1893, the year of the World's Fair at Chicago, and the electrical installation at the fair was for those days, unprecedented in size On account of this and because there was little established data of the requisite quality of electrical equipment the fire insurance companies were worried about the possibility of a great fire starting at the exposition from inadequately insulated wires. At that time a young man named W H Merrill made the suggestion that an electrical testing laboratory be set up So well did he "sell his idea that he was given a small room and was indulged in the modest luxury of a helper a clerk and $350 worth of equipment for the job.

When the Chicago exposition job was done, Mr Merrill was told to go right on doing the same work for the Underwriters. He is doing it yet Today he is president of the Underwriters' Laboratories, Inc, of Chicago, but instead of the two helpers of thirty years ago the work keeps 150 busy And it is still growing

When it comes to telling just what sort of things the Underwriters' Laboratories pass judgment on, it is hard to include them under any single heading—unless one says, simply, "things.' And this would not be half as inaccurate as would be an effort to name them all within the space of this page The Underwriters interest pertains to everything that enters into the construction of any building that is to carry fire insurance, and then extends to devices designed to reduce insurance premiums of any sort whatever

The Underwriters want to know, and they make exhaustive tests in order to find out just how many chances there are in a thousand of a structure taking fire from sparks on its patent roofing, or from lighted cigarettes in the office wastebasket As a small instance, what is the fire risk in a particular make of electric curling iron? They don't know, so they test it and find out They do everything they can think of that could ever happen to red hot wires surrounded by a possibly defective shell Experience has taught them that no matter how foolproof an appliance is, no matter what instructions for its proper use come with it, someone will manage to do the wrong thing and quite likely start a fire Given daily use by thousands of people, no chance of starting a fire by some peculiar carelessness is too remote So at the Underwriters' Laboratories the electric curling iron is tried and tested and tortured It is "tampered with in every way, but always having regard to one thing—how might it start a fire? This is only one example of the many tests.



Burglary insurance underwriters testing out an alarm, to find whether a cracksman could disconnect the gong without breaking the wires and turning in an alarm

Necessarily, since all kinds of things are to be tested, the big Chicago laboratories include several kinds of work. There is a chemical laboratory; an electrical laboratory, a mechanical and a hydraulic laboratory, a fire-testing laboratory, and several others. In all these laboratories there is an immense amount of testing apparatus, and it has to be added to continually because there is no uniformity in the nature of the things to be tested When a brand-new device reaches them someone has to think up a new apparatus to test it with.

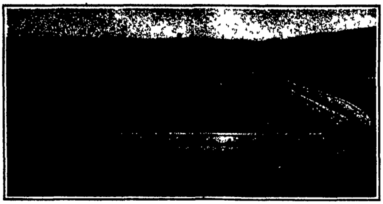
Manifestly it is impossible to test every item of every manufactured product in the Chicago laboratories. Last year six hundred million labels were pasted on approved products. The result is that much of the work must be conducted outside Wherever in the nation things are made the Underwriters' men must go. For, if only a sample of a given product is tested, what assurance is there that the output will be kept up to sample? To get around these difficulties the Underwriters divide their work into three phases. There is the re-examination service, involving such products as fire-pumps, acetylene generators and electric welding machines—devices which, because of their size and cost, are relatively less likely to be cheapened after testing a sample and on which it is safe to make tests only one or more times a year Then there is the inspection service, which is somewhat more thorough, applying to such articles as sprinkler equipments to which it is impracticable to affix labels. Lastly, there *is the label service which requires that one of the* Underwriters' 250 outside inspectors shall make frequent visits to the factory, often by surprise, and following closely a rigid specification of requirements issued by the Underwriters Laboratories decide whether a given lot of goods has been kept up to the standard required for the release of the magic word "Inspected."

There is no compulsion on any manufacturer to have his product inspected, but the service has come to have such a reputation for honesty and reliability that its approval is a highly valuable asset to him. This the Underwriters do not begrudge or envy, but it is really an accidental by-product of their work For the maintenance of their work proceeds from self-interest.

Returning from the field to the Chicago laboratories and choosing for illustration something which is obviously important from the point of view of inflammability, roofing materials undergo three kinds of tests. First, it is approached within ten inches from a plate of iron heated to 1100 degrees Fahrenheit and held there until flames break out. The time required gives a test on the fire-resisting qualities of the roofing with regard to the heat of radiation, alone. Next, a standard sized brand is let burn itself out while lying on the roofing. This gives a test of the fire-resisting qualities with regard to brands flying from adjacent buildings. The third and severest test is the wind driven flame test, which forms the subject of our current cover design A roaring mass of oil-flame driven by a 12-mile artificial wind attacks the surface of the roofing until it is ignited. The time required for ignition and the rate of spread over the roofing are noted.

Automobile Race Track on Factory Roof

TO EXPEDITE the testing of its automobiles under actual road conditions and at varying speeds, a well-known Italian automobile company has constructed on its factory roof what is no doubt the first race track of its kind. As the automobile chassis leave the assembly shop, they are placed on an elevator and carried to the roof of the factory in which they have been built, where, more than 100 feet above the level of the ground, there is a test track 75 feet wide and nearly three-quarters mile around, on which the chassis can be run under the direct control of the staff engineers. The track, formed of two straight stretches united by banked curves 20 feet high, permits of operating the cars at the highest possible speeds.



General view of the factory-roof race track and one of the four courts in the center of the plant Workshops for making adjustments, placed under highly banked curves, are reached by inner track

The odd automobile testing track occupies the greater part of the roof of an immense rectangular factory building at Lingotto, a suburb of Turin The works consist of two main parallel blocks, united at their ends and measuring 1270 yards around The space between the two main blocks of buildings is divided into four large courts by three transverse buildings, which afford ready communication between the five floors of the factory, by means of four electric elevators in each transverse building In all, there are seventeen electric elevators in this huge plant

The roof test track is constructed of reinforced concrete with a special kind of asphalt as top dressing. A thick concrete wall five feet high, on each side of the two straightaway sections and on the inside of the curves, as well as a wall nearly ten feet high on the outside of the curves, ensures safety for the drivers. Advantage is taken of the extreme banking to install workshops in the available space below the track These workshops are used by the test drivers to make the necessary adjustments on the chassis after the trial runs.

The straightaway stretches of the track are slightly cambered in order to allow water to run off into the gutters on the sides. As the hot water heating pipes are carried on the ceiling of the shops immediately under the track, there is sufficient heat to melt snow as it falls, so that the race track is available throughout the year

Chassis to be tested are brought up by electric elevators in the transverse buildings. After receiving their quota of gasoline and oil, as well as water for the radiator, the engines are started and each chassis sets out on the track for a preliminary run of ten or twelve laps. On returning, each driver reports in writing to his chief, who examines the chassis and then turns it over to other drivers for further tests, each driver reporting in turn If any defects appear, the chassis is returned to the factory Chassis which pass the tests satisfactorily are sent down to the body department or for delivery, as the case may be. After the bodies have been fitted, further tests have to be carried out on the track in order to ascertain once more that all the mechanical parts function correctly, and that the electric lighting and starting system operates satisfactorily

From morning until night the roof track represents a scene of bustling but well-ordered activity At regular and frequent intervals the elevator doors are raised, a chassis is pushed out, and a few minutes later it joins the group of all kinds of vehicles from bare chassis to finished limousines milling round and round the speedway Heavy trucks keep low down on the banked curves, while sport chassis spin around near the top.

Another view of factory-roof race track, showing a banked curve 20 feet high. High speeds can be developed in safety on this track

Express Company Equipment

TRANSPORTATION with an express company must be reduced to a science. No sentimental selection of equipment or guess-work method of operation or slipshod method of maintenance can be tolerated. Edward H. La Schum of the American Railway Express Company gives some interesting facts regarding equipment used by our largest express company

During the past year more than 184 000 000 shipments were handled and these shipments had to be handled at least once at point of origin and at least once at point of destination, in addition to handlings en route The average weight per shipment was approximately 82 pounds, producing a gross revenue of approximately $294,000 000. From the magnitude of the business it can readily be seen that it is necessary to make a most careful selection of vehicle equipment

In New York City the company requires 655 motor vehicles and approximately 900 horse-drawn In Chicago they use in daily service about 648 horse-drawn vehicles and 306 power vehicles, including 25 tractors with about 60 trailers. The total vehicle equipment throughout the United States and Canada consists of 2036 gasoline vehicles 1195 electric street trucks 324 electric industrial platform trucks and 100 semi-trailers about 8500 horse-drawn vehicles, which means a total of 12,755 units of which approximately 33⅓ per cent in numbers are motor vehicles with 50 per cent of the total capacity Statistics show that in express service the horse-drawn vehicle averages approximately 12 miles per day, , the electric vehicle 20 miles per day and the gasoline vehicle 30 miles per day, which surely is sufficient advantage to justify their predominance

The Acid Test for the Eight-Wheel Truck

SOME interesting and unusual tests were recently made with the eight wheel motor truck recently perfected by Mr R. B. Fageol of San Francisco One of the right rear wheels was run upon a block 10½ inches high Measurements were then made which showed that the trunion was only raised 4⅛ inches. In another test one of the rear wheels was run upon a block 12¾ inches high During this test the trunion was only raised 4½ inches or only three-eighths more than with the 10½ inch block

All of which is due to the unique spring construction There are two sets of springs on each side which are connected The trunion is free to rotate in a bearing which is carried between the upper and lower springs on each side, and it was because of the flexibility of the axle construction that the trunion was raised only 4½ inches when one of the four rear wheels was on the top of the 12¾ inch block

In another test the truck was run over railroad tracks without causing any jar or jolting of the passengers.

This truck recently carried seven tons of cast iron from San Jose to San Francisco, a distance of 51½ miles, in two hours and fifteen minutes. Two men rode in the cab and they stated that the truck rode as easy as a touring car

This truck can carry nine tons and tow a trailer or trailers carrying 11 tons, or a total of 20 tons, at a sustained speed of 35 miles an hour It made six miles on a gallon of gasoline while carrying 7½ tons.

Experts who have seen this eight wheel truck in operation claim that it has many advantages over the four wheel truck for rapid transportation of large loads of perishable goods, such as fresh milk and ripe fruit The extremely flexible axle hanging of both front and rear sets of wheels eliminates three-quarters of the road shock The milk is not churned nor the fruit bruised

The small wheels with low spring suspension bring the weight close to the ground yet allow ample road clearance Rocker action of trunions keeps the wheels down in contact with the road thus providing sure steering and constant traction Skidding or overturning is impossible in any ordinary operation of this truck Eight wheels and small tires ensure positive steering of this car in spite of blow-outs or even the loss of a wheel Hydraulic brakes on all eight wheels provide easy and sure control of a heavy load Speeds up to the legal limit can be maintained with safety and when emergency demands that the limit be disregarded the brakes and steering are such as to justify any speed of which the vehicle is capable

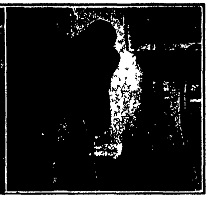
The front and rear wheels are all alike, and the small ordinary stock tires are inexpensive The weight is evenly distributed and the load balanced so that the front wheels carry their proportionate load, instead of the load being concentrated on the rear axle It follows therefore that moderate tire pressures are sufficient Elimination of slippage and skidding save wear on driving tires. Internal steering pivots permit the front wheels to run straight, thus avoiding wear of tires due to customary "toeing in" Brake linings are durable on account of large brake area and even application Fuel is not wasted in bouncing and racing of the driving wheels over irregularities of the road

Freedom from twist and jar secure long life of frame and body of the truck Minimized weight per wheel gains approval of highway supervisors Pavements are saved from concentrated impact and tires from overloading, by eight points of contact with the road. Free steering easy braking and comfortable riding leave the driver untroubled to watch the vigilance, according to the claims made by the designer of this novel truck

Eight-wheel motor truck with one of its right rear wheels on a 10½-inch block. The trunion was raised only 4⅛ inches, due to the unique spring construction

Rebuilding a worn axle

A 46-inch slab shear, welded for $833. New plate would cost $4500



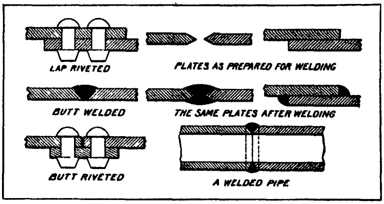
Repairing locomotive frame in place

Electric Welder Vs. Riveter

The Past Successes and Future Promises of Electric Welding

AMONG the many valuable services rendered by electricity must be reckoned the art of electric welding, which already holds an established position and promises, as it breaks down old, established prejudices to monopolize certain constructive and repair work for which it is peculiarly well fitted Although the recognition of the value of electric welding is of comparatively recent date, it was successfully done by Elihu Thompson nearly half a century ago, and down through the years it was used in a more or less tentative way until the Baldwin Locomotive Works and the Erie Railroad began to make systematic use of it on a large scale *The Baldwin Company did not hesitate to* apply it in boiler construction and the various locomotive builders and the railroad shops of independent railroads in the United States have employed it both in boiler construction and repair work and in the repairing of broken cast iron cylinders The Erie Railroad in particular, for many years has secured excellent results in using *the short regulated arc* in the repair of its locomotive cylinders For locomotive work one great advantage of electric welding is that a large number of repairs can be made without withdrawing the locomotive from service

The very gratifying success which arc welding has achieved in locomotive building and repair work now bids fair to be duplicated in marine work *Here its* efficiency was most dramatically demonstrated when the United States Government seized the German ships which were lying in our ports and determined to turn them into transports for carrying the United States troops to the theater of war in Europe Although this is an old story it is so pertinent that the outstanding facts may well be recapitulated



Comparison of riveted and welded joints

When our entry into the war became evident to the German Government, *they sent instructions to the* officers of the German ships in our ports to so thoroughly disable the engines that it would be impossible for us to make use of them for a period of from eighteen months to two years In carrying out these orders, the German engineers were careful to destroy the engines in their most vital parts and to injure them in such a way that it would be necessary to make exact drawings, prepare patterns from these drawings and make new castings This would have necessitated the gathering of a large force of draftsmen and the placing of a burden of some very heavy work upon the builders of marine engines, although at the time draftsmen were scarce, and our shipbuilding yards and engineering shops were already very crowded with rush orders The Germans of course were familiar with electric welding, but they had not themselves ever done any satisfactory welding of cast iron, they evidently believed that we knew no more, if as much of this matter as they themselves. It was stated indeed by the Secretary of the Navy that, after a survey by representatives of the United States Shipping Board, it was decided to make new cylinders, valve chests, etc so badly were these parts broken on the damaged ships

While the subject was under discussion, a few of the ships were transferred to the Navy and sent to the New York Navy Yard for repairs. Here Captain E P Jessop, after conferring with an electric welding company, recommended that the broken cylinders be repaired by welding In this he was heartily supported by Rear Admiral Burd the Industrial Manager of the yard and ultimately the Bureau of Steam Engineering issued orders to make the repairs where possible by electric welding, and to resort to mechanical patching only where welding was impracticable. Some of the accompanying illustrations show the character of the breaks in the cylinders etc, and give clear evidence of the serious nature of the injuries. So bad were they that a memorandum of the injuries written in German and found on one of the ships, ended with the significant remark "Cannot be repaired' Nevertheless, all *the ships were put in shape and ready for sea duty* within five months' time and the sections which were then welded in place have held and gave no trouble whatever after long and arduous service in carrying our troops to Europe and bringing them back again.

In a report on the matter, the engineers in charge of this particular work say that on the cylinders of the twenty vessels of German origin, not counting for a moment the turbine-driven "Vaterland," there were no less than 118 major breaks. Had not arc welding been available, the repairs would have entailed the renewal of some seventy cylinders. It should be noted, that in spite of the large scale of the damage, the work was done in place on the ship, the cylinders not being in any instance removed After careful estimate by the Navy Department it was established that the use of arc welding had resulted in the saving of twelve months' time and of $20,000,000 in money

We have referred already to the necessity for heat control where the electric arc is used The system used on these ships, and most successfully used elsewhere today, is what is known as the constant potential, low voltage system, which operates on a general voltage of thirty-five With this voltage it is possible to *deliver and maintain* a critical degree of heat at the weld, and to insure a proper fusing of the original and the added metal The metal to be welded forms one terminal of the circuit and the other terminal is a steel wire of a composition suited to the particular work This electrode is brought into touch with the metal and withdrawn until an arc about one-eighth of an inch *is established* between the electrode and the metal to be welded The great heat fuses both the work and the electrode, and the metal from the latter is deposited on the metal In preparing the abutting edges for welding they are so shaped as to provide a "V"-shaped depression, which, beginning at the bottom, is gradually filled up as successive layers of metal are deposited from the electrode Referring to the work done in repairing the cast-iron cylinders *on the German ships*, Captain Jessop states that investigation of the structure of the weld shows only a very slight vein of hard cast iron at the line of the weld, shot through with fingers of gray cast iron, while behind this area there is visible no heat effect whatever The metal thus deposited in repairing the German ships was easily workable with hammer, chisel, file or cutting tool Another very important feature is that, with the use of low voltage and absolute automatic current control, there is a minimum of heat transmitted to the parts to be welded, this being limited to the heat necessary to bring the electrode and the face of the metal to be welded into a semi-plastic state, thus insuring a perfect physical union.

Arc welding is being successfully applied not only in boiler construction, but in the building of large tanks for the storage of oil and in the construction of tug boats, barges and latterly in building small sea-going ships. In the above classes of work the electric welder is in direct competition with the riveter, and the accompanying line-drawing, comparing riveted joints with welded joints, en-

(Continued on page 295)

Left How the Germans drilled and then knocked out section of cylinder
Right Similar damage in a cylinder liner. Both welded and giving good service

A Rudder that Turns Itself

By Dr. Ernst Foerster

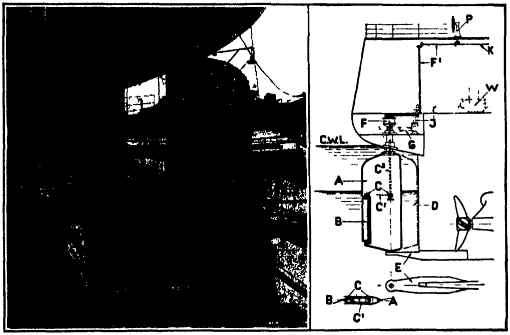
A CONSIDERABLE sensation was caused in European shipping circles when the new Flettner rudder was first adapted to the small sea-going cargo steamer "Frigido" of the Batavier Line. The idea of this rudder is to do away with power steering by steering engines entirely, using the turning effect of a small auxiliary rudder ("deflector") installed in the back part of the rudderplate, to move the main rudder. The combined effects of the small rudder working at a long lever, and of the power of the current acting upon the whole system, give a turning movement on the main blade with the effect of a prompt and energetic steering action. The motion of the small rudder is controlled by means of a mechanical gear, composed of a pair of yokes and horizontal rods, transmitted vertically through the hollow axis to the head of the main rudder post. In the case of the "Frigido" there is a drum connected with the top of this gear upon the rudder head, whence a steel rope axiometer gear passes to the wheel on the bridge. After this 200-ton vessel performed satisfactory service for 2½ years it was decided to apply it to a larger vessel, the "Odenwald," of 5000 tons register

The operation of the rudder will be made clear by a study of the accompanying line drawing, which shows the essential features of the device A vertical shaft, operated by the steering wheel at *P*, is geared to a horizontal shaft, *K* This, in turn, to a vertical shaft *F'*, which by means of bevel wheels at its lower end serves to operate a length of horizontal shaft, which terminates above the rudder post, *F*, of the main rudder The rudder post, *F*, is hollow, as is also the main rudder, *A* The horizontal length of shaft above mentioned is geared, by means of bevel wheels, with a vertical length of shaft which passes down inside the main rudder post, where it carries at its lower end a yoke, *C*, which, by means of a pair of horizontal rods, is attached to another yoke at the head of the small pilot rudder, or deflector *B*, located at the after end of the main rudder It will be seen that by operating the steering wheel, *P*, the pilot rudder, *B*, may be caused to turn to port or starboard, at the will of the steersman When the pilot rudder is turned to port, let us say, the rush of water results in a pressure to starboard, which, acting on the long lever arm represented by the distance from the pilot rudder to the axis of the main rudder, exerts a powerful pull to starboard and throws the main rudder to starboard. Similarly, if the steersman turns the pilot rudder to starboard, its action will pull the main rudder over to port Furthermore, the turning moment will be proportional to the amount of deflection given to the pilot rudder, and the main rudder will assume the desired angle of helm.

The "Odenwald's" rudder, which was built by the Deutschen Werft with all the necessary gear, has about 140 square feet of surface The deflector has about 12 square feet. Both are partially balanced, and both are fish-shaped in their horizontal sections and hollow The turning gear of the deflector is independent of the motion of the main rudder, the latter being able to move freely in a complete circle like a weather cock This always happens, when the ship is to go astern. Then the rush of water toward the propellers automatically turns the rudder through 180 degrees, and it then acts as a bow rudder The steering principle then remains the same, the pilot and the main rudder acting very promptly under the influence of the propeller suction. The main rudder reverses itself under the influence of the astern turning propellers before the ship herself has begun to go astern The deflector gear leading from the rudder head to the wheel on the navigating bridge, in the case of "Odenwald," is a rigid one, with one-inch round steel rods carried in bearings on deck and provided with suitable gear wheels. This gear has worked satisfactorily on a 30-hours' trial, when the vessel was steered by the hands of a wheelman, and the ship was placed in regular service without any material alterations, the only change being the substitution of ball bearings to reduce friction

The Hamburg American Line, as owners of the "Odenwald," have combined this invention, on board this ship, with another one of no less importance, called the "Anschütz-Kreiselkompass-Selbststeurer" Dr Anschütz' well known invention of the gyroscope compass has been developed by the same inventor to take the place of the wheelman This result has been obtained by the following method At the circumference of the compass are electric contact points, opposite to which a single contact point is fixed to the body of the gyroscope In the lower part of the compass-house, an electric motor of about one-half horsepower is provided, which is connected by a Gall chain to the axis of the steering wheel The motor is controlled by the above-mentioned system of contacts, depending on the turning motion of the ship The officer of the watch fixes the course which the ship is to follow—the rest is automatically done and continually corrected by the gyroscopic-electric device just described The steering is more exact than that by an actual wheelman, and it has the advantage that it never gets tired

One marked advantage of this automatic steering is that the course is straighter than that achieved by hand steering, with which a more-or-less wavy wake results.



This rudder is operated by the small pilot rudder B which is pivoted at the after edge of the main rudder A. Pilot rudder is operated by steering wheel P, through shafting F', F, C and yokes and link C C'

Earthquakes

FROM the very earliest times the attention of man has been arrested by earthquake phenomena. This is particularly the case in those countries which have been perturbed by disastrous shocks The Chinese and Japanese records contain frequent references to the destructive effects of the larger shocks. The importance attributed to such events may be well illustrated by reference to the chronology of the Jews. The great earthquake which occurred in the reign of Uzziah was used as a datum point to which subsequent events were long after referred

Such events could not come and go without arousing curiosity and speculation as to their origin In uncivilized or semi barbarous communities these speculations either attributed the cause of earthquakes to the movements of some subterranean monster or to supernatural agencies. Among more enlightened peoples a more rational attitude of mind prevailed For example, Aristotle, Pliny and others held the view that the movements were due to imprisoned wind or vapors seeking to escape from beneath the earth—a view after all not far removed from the more modern theory of a volcanic origin for earthquakes.

As the horizon of man became wider through geographical discovery the intimate relation between the distribution of volcanoes and earthquakes became apparent, and it was natural that earthquake phenomena should be attributed to volcanic energy This has been the dominant view of the last century, and prevailed until its last decade. This may be seen from the view expressed by Milne, the father of modern seismology, as late as 1886. He says, in summarizing a discussion on the causes of earthquakes, Although it would be an easy matter to discuss the relationships of earthquakes and other phenomena, we must conclude that the primary cause of earthquakes is endogenous to our earth, and that exogenous phenomena, like the attractions of the sun and moon and barometric fluctuations, play but a small part in the actual production of these phenomena, their greatest effect being to cause a slight preponderance in the number of earthquakes at particular seasons. They may, therefore, sometimes be regarded as final causes. The majority of earthquakes are due to explosive efforts at volcanic foci The greater number of these explosions take place beneath the sea, and are probably due to the admission of water through fissures to the heated rocks beneath A smaller number of earthquakes originate at actual volcanoes. Some earthquakes are produced by the sudden fracture of rocky strata or the production of faults."

This volcanic theory is now generally abandoned as the chief or even as a very important cause of earthquakes though it is, of course, admitted in special cases.

Earthquakes are now almost universally recognized as being of tectonic origin This change in opinion has been brought about chiefly through the labors of M de Montessus de Ballore and the late Edward Suess. Both these authorities have demonstrated the intimate relations between lines of crustal weakness and the distribution of earthquake foci M. de Montessus de Ballore has attacked the problem on a grand scale, taking the world for his province. Suess has particularized and demonstrated the relation for such districts as the Murz Line, Calabria and other centers. The most striking demonstrations of the truth of the tectonic theory were afforded by the surface displacements along fault lines during the Mino Owari the Assam and the California earthquakes. A great many other workers among whom, perhaps, Omori and Davison are pre-eminent, have long since investigated the relation of earthquake centers to fault planes and the tectonic origin of earthquakes may now be regarded as being firmly established —*Abstract from article by I C Cotton in the Bulletin of the Seismological Society, Nos 2 and 3, Vol 12*

Proof of Einstein's Theory from the Atom

THE light from the interior of the atom, as well as the light from the distant stars, gives evidence in support of the Einstein theory of relativity according to Professor A Sommerfeld of Munich

According to the modern view of the internal structure of the atom there is a central nucleus of positive electricity around which revolve at high speed one or more negative electrons. These may move in circular or in elliptical orbits as do the planets around the sun If the orbit is a circle the revolving electron moves at an even speed throughout its course But if the orbit is an ellipse the electron must move faster when it is making the turn nearest to the central nucleus at the focus than when it is at the more distant end of the ellipse This difference in speed would make no difference to the mass of the electron according to the old Newton theory, for this assumed that mass was unalterable But according to the new Einstein theory, a particle moving at high speed is heavier than when moving slower, so that electron would vary in mass in different parts of its elliptical orbit and therefore the energy it gave off in the form of light would depend upon the shape as well as the major diameter of the orbit

There are only a limited number of such orbits that an electron can pursue, and in slipping from one of these to another a certain quantum of light is given off which may be recognized by its position in the spectrum. The light given off from the incandescent gases, hydrogen and helium, as well as the X ray spectrum of heavy metals like platinum show that the corpuscles making up the atom obey Einstein's law instead of Newton's. Thus Einstein scores still another point

Psychic Adventures on the Continent

Sittings with an Apport Medium in Berlin, and Interviews with Several Notables

By J. Malcolm Bird

Associate Editor, Scientific American, and Secretary to the Scientific American Psychic Investigation Committee

With the present article, Mr Bird concludes his accounts of his informal sittings with European mediums. He has had one more informal sitting in this country which will ultimately be described in our columns, and the prospects seem good that he will have further seances of this character, in addition to the formal test sittings held before our Committee. In the meantime, there will shortly appear, under the title "My Psychic Adventures," a book in which he will describe, much more fully than he has had space to do in these columns, his impressions of and experiences with the mediums whom he has met informally.—The Editor.

If ONE were blocking out independently, a psychic tour of Europe, one would probably devote more time to the Continent than to England. My expedition, however, had primarily to do with British mediums, and only secondarily with items of psychic interest in France, Germany, etc. Nevertheless, it was my intent to give as much time as possible to a swing through the Continent, and I finally got away from London on the evening of March 13, immediately after my sitting with Hope described in our June issue. Beyond the knowledge that Paris was my first point of call my schedule was left to form itself as I went along.

In Paris I had very interesting conversations with Dr Geley, research officer in charge at the Institut Metapsychique International, and with Prof Richet whose recently published book "Thirty Years of Psychic Research" will be reviewed in these columns at an early date. I need say nothing here about these interviews, since I arranged with Dr Geley for several signed articles, in which he will tell of his work and of the general state of psychic research in France better than I could possibly do on the basis of such short examination as I was able to conduct. I saw Dr Geley's laboratory and his museum and was enormously impressed by the paraffin gloves obtained allegedly as casts of the hands of materialized spirits in the presence of the Polish medium Kluski. These casts have not been adequately described in America, and were it not that I have on my desk at this moment a letter from Geley announcing the dispatch within a very few days of a comprehensive article on them, accompanied by photographs, I should pause longer over them here.

Before and after leaving London I had been in communication with Dr Alfred Gradenwitz the very valued Berlin correspondent of the Scientific American. I had been anxious for him to go to Munich and meet me there since at the moment the Bavarian capital seemed also the psychic center of Germany. Illness in his family made this impossible however, and at his urgent recommendation I went to Berlin first, as his radio message said "on matters of psychic and editorial interest."

Dr Gradenwitz had arranged for me first to see the Grunewald psychic laboratory which he had already described in our issue of July, 1922. I found the apparatus extraordinarily interesting, and Herr Grunewald no less so. Then arrangements were made for a seance at the apartment of Frau Vollhard, and this was held on the evening of March 20.

Frau Vollhard is entirely in the hands of Dr F Schwab, a practicing physician who has been examining her mediumship for several years. Dr Schwab had it all settled in his own mind that as the price of the seance I was to agree, sight unseen, to publish in the Scientific American an article which he had written about his medium. My categorical refusal to do anything with this article beyond reading it and making a recommendation to the home office threatened to bring us to a deadlock, but we finally found a way out. I agreed to pay him a seance fee of ten dollars, and to read the article. If I then found it worthy of translation and reproduction in our columns, I was so to recommend, and if it was thus used, the ten dollars was to be deducted from our payment for it. When the article reached my hotel the next morning I was agreeably surprised, it was by no means as hopeless as I had feared. The accompanying photographs are from it and a good deal of the accompanying information about the medium. I suppose we must forgive the middle class German for getting excited in the presence of anyone who has access to the fountain of dollars.

Dr Schwab first became acquainted with Frau Vollhard in the fall of 1920. Prior to her work with him, she sat only in the most restricted circle of her intimate acquaintances. At these sittings telekinetic phenomena occurred, with numerous apports. Nothing was seen of ectoplasm or materializations.

Telekinesis, the movement of objects without contact, is familiar to my readers I have no doubt. Apports perhaps are not. The idea is simple enough, and plausible enough. If a given force can move a vase of flowers across the room, it seems self evident that, applied in greater concentration and with greater power, it can move a man across London or a table across a continent. In its simplest terms, the apport is simply the bringing into the seance room, of a material object that was not there before. The spiritists are very clear indeed that the object is not materialized out of nothing. It is brought from somewhere else, and disappears from this other place just as it appears in the seance room. The identification of the phenomenon with telekinesis seems immediate until we learn that an apport is just as likely as not to occur in a sealed room. Then there enters the very pretty problem of how the extraneous object got through the walls. The believer finds this simple enough, it was dematerialized, filtered in through the molecular interstices, and was reassembled within the room. If the phenomenon really occurs, some such explanation as this must presumably be accepted.

To return to Frau Vollhard. Dr Schwab, soon after his admission to her sittings, set about to remodel them in the interests of science. He set up better controls and better conditions for observation, brought in apparatus of various sorts, kept a permanent record of all the seances, interested other scientists and got independent witnesses, carried out medical and anatomical tests upon the medium, etc., etc. Frau Vollhard was sufficiently impressed by his plea of scientific expediency to have submitted to all this. But she has a limit beyond which she will not go. In conversation about her tea table, the abstract proposition was advanced whether she would qualify for our formal investigation. Her interest was acute when I translated $2500 into marks at 20,000 per dollar, the prevailing rate, but she was very certain that, even for the purpose of winning such a colossal sum, she would not sit in other than her own clothes and would not submit to more than a perfunctory search.

With Dr Schwab's introduction of science into the seance room there came a surprising shift in the medium's scope. When he first tried to get photographic evidence of telekinesis, he found ectoplasm in the developed picture, and pursuing this lead, he got very many photographs and visible appearances of this much controverted substance. One would be fairly certain that the medium was not sufficiently well-read to know anything about ectoplasm, or sufficiently clever to counterfeit it. Her daughter is always present, however, and with regard to her neither of these assurances would be valid. If there is fraud, she I would be certain is the guilty one.

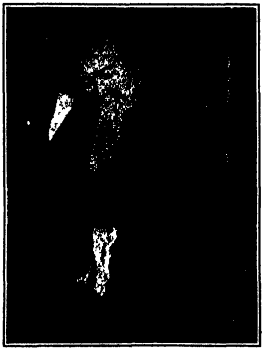
Not long before the date of my sitting, the medium had without apparent reason abandoned the production of ectoplasm, and returned to her original line. So I was given reasonable assurance that I should have some apports, and made to understand that nothing else was likely to occur.

The medium sat at the end of a small oblong table. On one side Dr Gradenwitz and on the other I, sat at the side of the table around the corners from Frau Vollhard. Next to me came Dr Schwab and then the medium's daughter on Dr Gradenwitz' side sat two gentlemen who were present for the first time. One was a Herr Inspektor, and the other was apparently also the holder of some official position. There was complete darkness save when Dr Schwab flashed his red torch to make an observation of some sort.

There were no preliminaries. We simply sat down and waited, conversing. The medium was greatly relieved to learn that I was not a violent skeptic and even more so when she discovered that I could manage to keep up with the conversation. She had apparently had a mental picture of Dr Gradenwitz and myself, exchanging impressions in English, of which nobody else present would understand a word.

We had been sitting for but a moment or two when she began making weird noises. She breathed rapidly, shuddered and groaned, and occasionally cried out loudly. The medical man who is present when a female medium acts in this fashion usually notes a good deal

(Continued on page 295)



Frau Vollhard caught in the act of producing ectoplasm

Another characteristic view of a mass of ectoplasm

A Waterproof Motor for Lifeboats

By H. C. Bywater

WHAT is probably the most reliable marine motor of its type ever made is a six-cylinder model developing 90 horsepower at 800 revolutions per minute which was recently completed for the Royal National Lifeboat Institution of London. No ordinary gas motor manufactured at competitive prices is reliable enough for the severe conditions of coastal lifeboat service, and those built for the above-mentioned Institution have always been of special design throughout. The latest and most powerful example embodies experience with motor lifeboats for the last 18 years. It is not a commercial proposition, the cost being prohibitive for any other purpose. In fact expense has not been considered, every device making for reliability being employed regardless of cost.

A good example of the care taken in the design to ensure absolute freedom from breakdowns is the use of six keys, solid with the shaft, which fit into as many grooves for fixing every important wheel and lever to its spindle, loose keys and screws being considered to possess remote possibilities of failure.

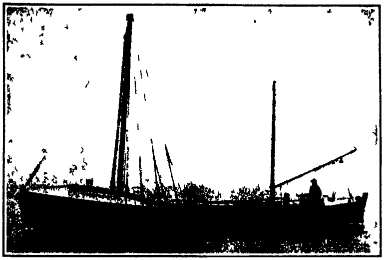
The watertightness of the motor with all its mechanism seems almost to savor of a mania for reliability, more especially as it is installed in a massive watertight case. Yet this feature is considered desirable and the motor would run if actually under water, standpipes being fitted to the carburetor air inlets to make this possible. One might well suppose that the risk of trouble from water could not be further guarded against, but it is, by the provision of a drain well in the case, in which a centrifugal pump runs continuously so long as the engine is working. If therefore any leakage should occur through damage to the case (a by no means impossible contingency) or, if the hinged flaps at the top should be open and a sea drive in, the water would be at once thrown out.

Even dual ignition was not considered reliable enough, and separate high and low tension gear has been fitted with what is practically dual ignition to each, the source of supply being either a dynamo or a battery which is charged by the dynamo. As insulated cable of a high enough standard could not be obtained, so a special quality was made for the Institution, of which the insulation remains effective if soaked in hot water or oil, while the high tension arrangements are such that no moving contacts are subject to high pressure.

Naturally very careful attention has been paid to the carburetors and the induction system, which in ordinary marine motors are the most fruitful sources of trouble next to the electric ignition gear. Two carburetors are fitted, one for each set of three cylinders, so that if one fails the motor will still continue to run. Each has two throttles, one of which is controlled by the governor and prevents the speed exceeding a predetermined maximum. The other throttle functions in a way which will be explained later. An unusual although a not unknown feature, is the use of exhaust gas to heat the petrol vapor and air.

The six cylinders have a bore and stroke of 5½ and 7 inches respectively. A common water jacket is in one casting with the crank case and forms the main part of the motor. The valves and their gear are carried in a detachable cylinder head, the valve spindles being worked direct by the cams, thus doing away with tappets, rockers and push rods. This involves an overhead camshaft with a vertical timing shaft between it and the crankshaft. All the ignition gear is also contained in the cylinder head. A light aluminum cover screwed down upon a watertight joint encloses the mechanism.

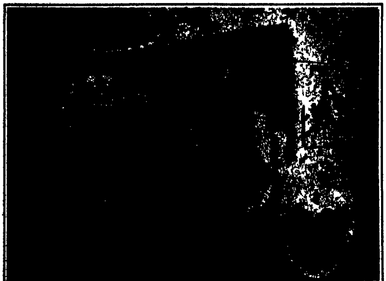
As a failure in the supply of cooling water to the cylinder jackets would mean the stoppage of the motor, the pumping and cooling arrangements have been most carefully devised to eliminate any possibility of failure. In the ordinary motor boat installation the pump draws water from the sea and delivers it to the cylinder jackets, whence it is discharged overboard. For lifeboats which sometimes bump over sandbanks this plan is not reliable. Experience has shown that sand is drawn in and deposited in the jackets. All lifeboat motor installations, therefore, are now fitted with closed circuits in which the water is pumped round and round, being cooled in nests of tubes which are immersed in wells to which the sea has free access.



Forty-five-foot motor lifeboat recently built for the Royal National Lifeboat Institution of London. Sixteen of these boats have been ordered

All the main moving parts in the engine are automatically lubricated, some by forced feed, others by splash or drips, none is left to chance. The oil is circulated by a gear pump. The engine is installed in the lifeboat in a copper lined wood case, the upper part of which is of steel plate and has hinged flaps which are screwed down upon rubber joints. All the controls and the connections to gages are brought to the outside of the case through watertight fittings.

This lifeboat motor is very easy to control, as after it has been started all maneuvers are carried out by the turning of one handwheel. The latter primarily controls the reverse gear, but its spindle is connected inside the engine case with the throttles above the carburetors as already mentioned above.



Absolutely enclosed and watertight engine, built, regardless of cost, for the lifeboat shown above

A 43 year old logging locomotive, at work in the Redwood Forests of California

A Veteran Locomotive

IN the files of the Bureau of Valuation of the Interstate Commerce Commission is an analysis of the life of over 8000 locomotives employed on nine western railroads. It was made by Mr. I. H. Adams, Mechanical Valuation Assistant on the Atchison, Topeka and Santa Fe Railroad. From this tabulation we learn that the average life of these locomotives was 31½ years. This is a tribute to the high quality of the materials and work put into American locomotives, and no doubt it will come as a surprise not only to the general public but to many of the railroad officials themselves.

So much has been said about the American policy of wholesale scrapping of machinery that is far from worn out in order to replace it by an improved and more up-to-date plant, that we have rather got into the way of believing that from 1[illegible] to 1[illegible] years marks the average term of usefulness. The locomotive, because of the very hard service to which it is put, was popularly supposed to be ready for the scrap heap rather early in its career, the more so because the rapid increase in size, the equally rapid improvement in details and the large annual output of new locomotives would seem to demand that annually a corresponding number of by no means old engines would be relegated to the scrap heap.

As a matter of fact the older and less powerful engines, as they become unequal to the task of hauling the heavy trains both in passenger and freight service, are relegated to lighter service and continue to do good work on the less important branches and on the feeder lines of our great railroad systems. This is as it should be, for if a locomotive receives the benefit of careful maintenance, and is sent regularly to the shops for a thorough overhaul, there is no reason why its life should not be extended, if it were desirable, to cover the half century.

We present as a striking instance of prolonged work in service, an illustration of a little Baldwin locomotive which was the first one to operate in the redwood forests of California. It was completed and sent to San Francisco in 1880. As will be seen, it is a four wheel tank locomotive with spark arrester smoke stack, built to the standard gage of 4 feet 8½ inches. The cylinders are 12 by 16 inches, the driving wheels are 34 inches in diameter and the weight when the engine was equipped with fuel and water is about 38,000 tons. It will be seen that the tank, which is of the saddle type, is carried above the boiler and the fuel in a box at the rear end of the foot plate. We are told that the specification called for fuel that was to be "wood of poor quality."

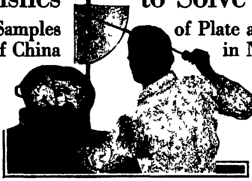
When it reached San Francisco, the 'Sequoia' was dismantled and shipped by a sailing schooner to Trinidad, Humboldt County, California. The harbor was an open roadstead and the different parts of the locomotive had to be landed by means of a logging derrick. The little engine was a source of great wonderment to the Klamath Indians, who were constantly begging for rides. Hence the little 'Sequoia' would not infrequently come puffing through the woods with Indians perched on the front bumper, on the top of the cab, or wherever they could hold on.

It is related that when Dr. Edward H. Williams of the Baldwin firm was on one of his business trips to Russia he took with him a print of the photograph from which our illustration is made, and when it was shown to the Russians, they found it difficult to believe that logs of the huge size hauled by this little train were obtainable.

Smashing Dishes to Solve Their Secrets

Why Uncle Sam Breaks 6,000 Samples of Plate and Window Glass and More than 2,000 Pieces of China in Novel Tests

By George H. Dacy



More than one thousand valuable plates have been shattered in the crockery strength test

THE CRASH and clatter of broken crockery and glassware resound nowadays in one of the national ceramic laboratories at Washington, where Uncle Sam is testing out all kinds of glass and chinaware for durability and service. A huge testing machine that is capacitated to develop a pressure as great as 100,000 pounds is used as one of the agencies of glass destruction. This mammoth apparatus is employed to try out concentrations of force at different points in the glass specimens. By its use accurate data are obtained relative to the aggregate strength of various kinds of glass for different purposes—information that previously has not been available.

All kinds of building glass, such as window glass, are being surveyed. A curious water pressure system is used to simulate the wind pressure which the western zephyrs often exert against the window panes. This experimental setup also permits of securing data of great value to architects who sometimes have to plan and design aquariums and other structures made of glass, that are exposed to extremes of water pressure. The novel contrivance consists of a watertight metal framework which is so devised that a sheet of window glass, flat side up and 43 by 46 inches in size, can be inserted between its top and bottom surfaces. There are special rubber guard rails that fit snugly against the edges of the glass and prevent any water from leaking away.

After the specimen of glass is in place, a small space about one-quarter of an inch in thickness is left directly above the glass. It terminates in a central glass tube which widens out into a funnel about 24 inches above the surface of the framework. A rubber hose from an adjoining water faucet provides a water supply which can trickle into the tube and fill the space above the glass. The water is allowed to run until its pressure is sufficient to break the sample of glass. A pane of glass three-sixteenths inch thick and 43 by 46 inches in surface dimension will break to pieces when the water in the tube attains a height of 14 inches. The glass will deflect one-half an inch before it breaks, so the Government tests have shown. A special recording gage is used to register the amount of deflection in each of the experiments. The action of the water and the pressure it exerts as the glass breaks, say when the water attains a height of 14 inches in the central tube, are the same as though the glass surface was covered with a solid sheet of water 14 inches high.

More than 5000 samples of plate and window glass—special strips two inches wide and 16 inches long—have been crushed to pieces on two other devices. These devices are used in measuring the transverse and lateral strengths of the glass specimens. The first outfit is so arranged that the sample of glass is laid flat side uppermost, with the two ends of the glass supported and a saddle attached to a scale bar suspended over the unsupported center of the specimen. A shot bucket is attached to the free end of the scale bar and so adjusted that when the trigger is tripped, shot from an adjoining shot tower will stream into the bucket. The shot pour into the bucket, in each instance, until the weight on the scale bar is sufficient to break the glass. The instant that the glass breaks, the shot bucket falls on a lever and automatically stops the flow of shot. The amount of shot in the container is weighed, and this weight is the index to the transverse strength of the glass sample.

The arrangement of the other apparatus is such that the strip of test glass is laid against a weight flat side up. A metal ball attached to a pendulum arm is drawn back a certain distance and then released and allowed to catapult against the glass. The process is repeated until the glass breaks. There is a graduated scale installed along the path of the pendulum so that the arc through which it swings can be measured each time the ball descends. The lateral strength of the glass specimens is ascertained in this way. The ball and pendulum scheme of destruction is also used in testing the durability of plates, cups and tumblers. In each case the piece of glassware or china is held against a heavy iron weight, the pendulum ball is drawn back and then dropped so that it smashes against the article of crockery. The test is continued in each case until the dish or glass smashes into smithereens. The cups and glasses are always held against the weight in such a position that their bottoms are exposed to the blows of the swinging ball.

In testing the ability of different kinds of glassware and china to withstand regular and routine sterilization, the individual pieces are exposed for five successive periods in boiling water, and thereafter they are completely immersed in a closed vessel having a small steam vent, so as to be boiled continuously for six hours. In this novel way data are obtained which indicate how the different dishes will stand up in restaurant and hotel service where mechanical dish washing machines are used. Study is also being made of the cobwebs of cracks which sometimes develop in china of inferior manufacture after it has been in use for a little while. The laboratory tests which have been made up to this writing indicate conclusively that made-in-America china and glassware are superior to the imported dishes and tumblers which heretofore have been purchased from French and German manufacturers in rather large quantities.

Dish breakage expenses are always heavy at leading hotels in this and other countries. A prominent Chicago hostelry reports that it costs more than $35,000 annually to replace the dishes that are broken. Other hotels estimate an annual loss of at least 20 per cent of the original cost of their total supplies of china and glassware. The fact that dish breakage is such an important factor in the leak and loss items of the average hotel explains the great interest and the cooperative assistance of the American Hotel Association which is aiding Uncle Sam in every possible way in his investigations. In fact, at present eight of the leading hotels of the United States and Canada are running service tests of French, German and American china. If these actual wear-and-tear experiments duplicate the results of the Federal laboratory tests, the swan song of imported china for hotel uses in this country is about to be sung. There is every evidence that the findings of the practical hotelkeepers will coincide with those of the Government scientists, that there is no crockery or glassware in the entire world the equal of that which is now made in the United States.

Stucco Investigation

FOR several years past, the Bureau of Standards has been studying stuccos, and many of its findings have been embodied in a "Recommended Practice for Portland Cement Stucco" which was formally adopted recently by the American Concrete Institute as one of its standards. The practice covers the application of stucco to all bases, and although a masonry base is probably capable of giving the most dependable results, it is recognized that there has been and probably will be for many years to come a larger use of stucco on frame houses than on masonry structures.

The application of stucco to frame houses involves greater uncertainties in results than on masonry bases, and in order to solve some of these problems the Bureau proposes to carry out, in cooperation with some of the interested trade associations, a study involving about 30 test panels on the stucco test building. Considerable interest has been shown in this work, and a conference will probably be held in the near future. If the full cooperation of the interests involved is secured it is planned to start work early in the fall.

Left: Large panes of window glass, 43 by 46 inches, are tested on this apparatus in which water pressure is used to simulate wind pressure. *Center:* The amount of shot, deposited in the bucket before the glass specimen breaks, is the index of its transverse strength. *Right:* Powerful testing machine, capable of exerting a pressure of 100,000 pounds if necessary, is used in determining the strength of the strongest of glass

Various ways in which the Bureau of Standards smashes glass to learn its strength

A Novel Use for Sugar-Cane Waste

SINCE the beginning of the sugar industry it has been the custom to use the waste products in a manner which is far from advantageous. Each year the sugar world produces an enormous tonnage of residual molasses, and an enormous volume of refuse shredded cane Neither is of any value as a source of sugar, yet the financial success of sugar raising hinges largely upon their economical utilization in some way

It has been customary to burn the bagasse, or refuse cane (also known as megasse), sometimes as fuel and sometimes merely in huge piles, as the easiest means of disposal It *will* burn—and that is about all that can be said for it. It has a moisture content of over 45 per cent, and this must be largely evaporated in the flames before combustion can proceed effectively Moreover, when used as actual fuel, it causes much scale in the boiler tubes and forms many clinkers, in addition to the excessive losses of heat

The molasses, on the other hand, can be converted into a rather high grade fuel and the ash from its burning is the finest sort of fertilizer possible for application to the sugar fields. If it were burned instead of the bagasse the latter would be available for other uses, with a large hope of the finding of these

Hawaiian planters are finding at least one use for the waste fiber which is extremely interesting Obviously some sort of paper can be made of it as of all plant fiber This is done, and the resulting product, "mulch paper," is used in the fields, being laid in strips over the rows of young cane As the cane grows, its tips penetrate the paper, and the sugar crop suffers no slowing up or diminution through the paper's presence But the weeds that infest the sugar field have not the sharpness or stiffness to penetrate the paper, and they are completely eliminated, so far as the portions of the field close to the sugar plants are concerned

A large plantation thus prepared for the growing presents a striking sight, as our photograph indicates. The fact that the bagasse can be thus utilized, with very large benefit to the crop, will doubtless lead to the experimentation necessary to effect a substitution of the molasses for the waste fiber as fuel, thereby completing the cycle of twentieth century sugar-plantation economy

Sugar field with mulch paper strips, showing how the cane pierces the paper, and how completely the weeds fail to do so

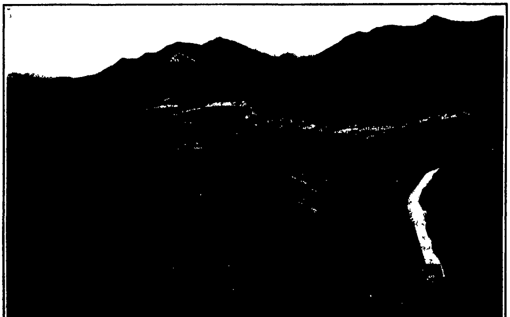
A New Silver Which Does Not Stain

A NEW stain resisting silver has been introduced recently in Great Britain and, according to a British trade paper, it has alarmed many retail jewelers. They seem to fear that the demand for the new metal may render their stocks of silverware less salable

The name of the new silver is "Silanca" It is the result of experiments to discover a method of making silverware which cannot tarnish in ordinary use The new material is said to be a brand of sterling silver which is described as an original and complex alloy While not absolutely stainless, Silanca resists tarnish to a remarkable extent and is said to show no fire marks at any stage of making up. The new alloy is pointed to as probably a relief for the household staff from the periodical cleaning of the domestic silver. To maintain its brilliance, the only attention required is an occasional rubbing with a clean chamois leather or a soft cloth Specimens so treated are reported to have a finish almost equal to new silver, which have undergone no other treatment over periods up to two years. The material is said to be proof against atmospheric oxidation and not affected by damp salt There is no need for glass linings in salt cellars made of this material

As supplied to the manufacturing trade, the metal is ductile and can be stamped, spun raised forged or drawn The maintenance of its color and brilliancy over long periods depends upon the proper conditions of working and involves some slight variations from ordinary methods The new material is particularly recommended for spoons and forks, especially fancy patterns in which, when made of the ordinary silver copper alloy, the presence of 'fire' gives so much trouble When melted under proper conditions Silanca is said to make satisfactory castings sound and free from pin holes, the details of the metal being more exactly reproduced than with ordinary silver

The inventors have been hampered in their work by the necessity of producing an alloy which is entitled to carry the official hall mark denoting standard quality The minimum proportion of silver to qualify for this mark is 92½ per cent so that all the work has had to be concentrated upon the slight margin of 7½ per cent of alloying medium "Silanca cannot be used as anodes in the electroplating bath The cost at present is about 10 per cent higher than that of standard silver, but strong hopes are entertained that this figure will be lowered as experience in handling the alloy is gained



The extraordinary banded appearance of a freshly planted sugar field, with mulch paper strips laid to keep down the weeds

Correcting Engraved Plates by Novel Method

ENGRAVERS and printers—and their number is legion—throughout the United States will be interested in a new and improved method of correcting engraved plates, or 'cuts," as they are popularly known The permanency of the impression contained on the electrotype is one of its strong virtues, and yet when corrections are to be made its unyielding attitude may be considered a disadvantage.

Charts, maps and various photographic productions of the Federal Government are frequently subject to changes even after they have been engraved These corrections heretofore have been made by a cumbersom and time-consuming method involving the scraping of the electrotype and leveling it with a hammer on an anvil designed for the purpose The division of charts of the Coast and Geodetic Survey, United States Department of Commerce sought to devise a more ready way of making corrections on copper Assistance of the Bureau of Standards was enlisted, and the director of this Government agency assigned W B Bailey a chemist to study the problem His efforts coupled with the aid of the engraving and electrotype sections of the Coast and Geodetic Survey have been fruitful of results. Apparatus is now being built for correcting electrotypes in accordance with this discovery

E. Lester Jones director of the Coast and Geodetic Survey describes this method of correcting engraved plates somewhat in detail His statement is as follows

These experiments led to the adoption of an interesting, and it is believed novel, adaptation of the galvanoplastic method of electrotyping by means of which it is possible to remove quickly small or large areas from the surface of the plate to the depth of the engraved work thus clearing the metal for subsequent reengraving

An electrode is inserted in the nozzle of a hose through which a solution of copper sulfate is thrown under pressure against the plate on the area where the correction is to be made An electric circuit from a generating source is formed between the plate and the electrode in the nozzle, through the stream of solution impinging on the plate A current pressure of from 12 to 15 volts has been found satisfactory This voltage is far in excess of pressure ordinarily used in depositing copper, and the action is very rapid By making the plate the positive electrode, copper is removed from it to any desired depth The adjoining portions of the plate which it is not desired to correct or alter are not affected since they are filled with ink or any nonconducting substance

'By this erasing method a depression as deep as the engraved lines is made By the use of a hammer on the back of the plate the depressed area may be leveled with the surface and, after polishing, the plate is ready for the application of new work which ordinarily will be engraved upon the clean metal by hand

'Although the solution after striking the plate flows over it the only point affected is that against which the stream is directed Small areas of the surface are quickly removed as the engraved lines are not cut deeply

"The removal of about one-twenty fifth of the thickness of the plate usually erases all work likely to need correction After this depression is transferred to the back of the plate by bumping up, it may, if desired be filled in on the back by using the same process with the direction of the current reversed "

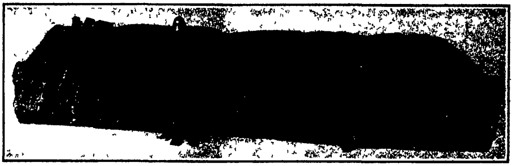
As indicated above, *the electrolytic action is rapid* An area about two inches square can be removed from a plate to the depth of the engraving in six minutes. This is beyond all comparison faster than any method heretofore used the difficulty always having been in the erasure, rather than in the reengraving

Why Armored Suits Fail

Some Facts Worth Knowing Regarding the Perforating Proclivities of Armor-Piercing Bullets

By Captain Edward C Crossman, U. S. A.

EVERY once in a while or even more frequently there bobs up a hopeful gentleman who has discovered that certain forms of alloyed and heat treated steel will stop most bullets Having bobbed up he makes known his purpose which is to try to sell the idea to the police or to the Army or other organization of which the members are likely to serve as targets for gunfire



An inch of mild steel, with an armor-piercing core of the old-style, light-weight type, protruding. Modern armor-piercing cores could readily slip through

Like altogether too many inventors, the armor suit gentlemen are little informed as to the ramifications of the problem they think they have solved and they do not realize that others have likewise invented armor suits which failed

The Ordnance Department of our Army used to have a special officer detailed just to "shoo away" the inventors of armor suits or armor shields for our soldiers during the war

The little joker attaching to the armor personal protection lay in the fact that like armored ships and big guns, neither side stayed ahead very long Another one was that steel undershirts, while reassuring are somewhat stiff and heavy, not to mention the minor feature that the other side in the war could drill holes in the best one ever made by merely putting a different type of cartridge into a plain infantry rifle

The armor piercing infantry rifle bullet wasn t one jump behind the various light forms of armor developed in fixed trench warfare, not to mention the armored tanks and other protection in fighting airplanes.

The United States had an armor piercing bullet before the Great War, and I shot it for trial before Germany commenced to defend the Fatherland in northern France

Early it was evident that a sheet of special heat-treated steel, one-eighth inch or less, would stop an ordinary jacketed bullet but alas, it would not even discourage the armor-piercer So armor for modern soldiers boiled down to the form used on tanks, to the massive and unwieldy German trench helmet covering face, head and neck to the shrapnel helmet, and to the special heavy shields used for snipers.

The armor piercing bullet is practically the same as used by all armies It consists of a miniature bullet, about .22 inch caliber for a .30-caliber bullet, a trifle shorter than the bullet in which it is going to be used and harder and tougher than any steel likely to be familiar to the ordinary man It will weigh, in the .30-caliber, from 60 to 90 grains.

It is set in a regular leaden core and that in turn encased in the regular cupro-nickel jacket of the ordinary infantry bullet There is thus a miniature .22-caliber very hard steel bullet, surrounded by thin leaden walls, and then in turn by the regular bullet jacket The leaden walls permit "give" enough to the bullet to seal the bore of the rifle against gas escape, and to take the rifling and spin the bullet Outwardly, such bullets look like any other except that they are longer than the standard and seem light for their length

On striking armor the jacket smashes to bits the lead disappears in a fine spray perhaps acting as a lubricant for the steel bullet within, and the steel core slips through an unbelievable thickness of the hardest steel

With the Clay bullet, inferior to the present Army form, I have shot through a 5/16-inch tough steel—but not armor—plate at the range of 700 yards. Such a bullet as the familiar 30-30 used by hunters not equipped with more up-to-date arms will not even dent the plate at this distance

The hole made by the armor-piercing bullet is, of course, merely the diameter of the core or miniature bullet in the case of our own, it is about .22 caliber or less than one-fourth inch Men behind the steel armor would therefore have only .22-caliber holes punched in them by the hard little missile Such a bullet will easily punch through a full inch of ordinary mild steel

One of the tests made at the Small Arms Ballistic Station was to obtain the ballistics of our new armor-piercing bullet, and incidentally we tried it against some of the armor plate on hand at the station

One type had the miniature bullet or core, as it is known, made of Firth sterling steel, and the core itself weighed 90 grains. The other had the core made of a tungsten alloy, weighing also 90 grains.

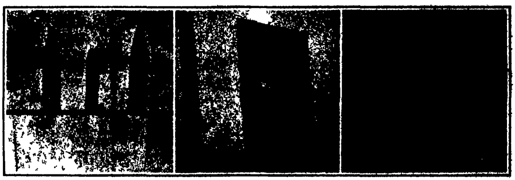
Using special heat-treated armor plate six-tenths inch thick, the Firth bullet put one core nearly through, sticking in the rear of the plate, while the other two tried, broke the back of the plate The tungsten alloy core punched three clean holes through the plate At 200 yards this tungsten core put a bad bulge in the rear of the plate, but did not go through. At 300 it also bulged the back of the plate

The complete bullet weighed 100 grains, as compared with 150 grains for the standard .30-caliber bullet, and was given a muzzle speed of 2550 feet per second compared with 2700 feet for the standard bullet. Both were, of course, to be used in the regular infantry rifle and machine gun

You can imagine, therefore, what use an armored suit or armored car would be, if armor steel more than half an inch in thickness can be easily punctured by a little bullet any soldier may be carrying in his belt, remembering that steel plate a half-inch thick weighs about 20 pounds to the square foot

Modern high velocity sporting rifle bullets will punch through a surprising amount of ordinary mild steel or boiler iron, and the higher the velocity, the greater the penetration Weight of bullet seems to cut little figure. The little 87-grain .250 Savage bullet, for instance, will punch a hole through a half-inch mild steel plate, where the 220-grain "Krag" bullet won't begin to get through. Always the hole made by these high-velocity bullets is much larger than the bullet itself, and it does not seem to matter in penetration whether the bullet is "soft nose" with the lead exposed at the point, or is full-jacketed with copper-nickel or copper. I have seen a bullet of .28-inch caliber punch a hole through half-inch steel, and the diameter of the hole was three-fourths inch instead of less than one-third, as was the bullet

So while light armor might stop pistol bullets or those from low-velocity rifles, none that might be worn and carried around by a man could stop an armor piercing bullet, indeed, it is doubtful if these inventor's suits for policemen could stop even a high-velocity hunting bullet in the 3000-feet per-second class of velocity



Left An old-type armor-piercing bullet and the steel core. *Centre:* Steel plate one inch thick, armor-piercing bullet of .28 caliber, and three-quarter-inch hole bored through plate. White strip is one inch wide. *Right:* One-inch thick mild steel, showing armor-piercing cores protruding through it. Note how the core and the steel tend to weld

A Free Balloon Without Top-Valve

DURING the 140 years since Montgolfier invented the free balloon, comparatively few important improvements of the invention have been made. It is true, that from the original free, drifting balloon, the dirigible balloon, more or less cigar-shaped, filled with hydrogen or helium gas and equipped with motive power, has been evolved, but there have been scarcely any changes in the free balloon. It is still of approximately spherical form, has a big escape valve at its apex, its ripping line and its rope harness from which the basket or gondola is suspended.

At last there seems to be a prospect of a material improvement by abolishing the clumsy and troublesome escape valve which rarely functioned properly and frequently was a source of great discomfort or danger to the aeronauts. When it rained, water would accumulate in the seat of the valve and run down the filling tube and on the heads of the occupants of the basket and their instruments when the release cord was pulled, in cold weather the felt packing would freeze, making it impossible to open the valve, or to close it after it had been opened.

In a recent German invention the hinged top valve is supplanted by a flexible tube, which reaches from the equator of the balloon to the filling tube at its lower end. The tube normally rests on the inner surface of the balloon, passes with its outflow end through an opening in the balloon tissue at the equator line and has, outside of the balloon, an extension consisting of a piece of very light tubing, about one foot long The inflow end is provided with a perforated metallic stiffening tube which prevents the mouth of the tube from being compressed and closed by the pressure of the gas in the balloon. The stiffened end of the intake normally extends well down into the filling tube, but may be raised by a line running over a pulley attached to the pole of the balloon to any desired height. When this is done, the gas below the intake end of the tube will escape. The rush of the released gas will cause the free end of light tubing to flare outward, thus indicating to the aeronaut that the tube is in proper working order

Another valuable improvement, also by a German inventor, consists of a small elastic gas bag, communicating with the balloon and provided with a whistle which gives a shrill sound when the rising of the balloon causes an increase in the gas pressure and makes release of gas in order Both inventions have been tried out under actual flight conditions and were found to be useful and reliable.

Sunburned Eyes—A Film-Studio Problem

When *one exposes one's skin to the rays of the* sun, one gets sunburned. Some people are much more susceptible to this than others, but everybody is somewhat susceptible. The cause is found, not in the visible rays and not even in the radiant heat waves that accompany them, but in true light waves of such short length as to fall in the invisible, ultra violet section of the spectrum. These have a powerful searing effect upon the human epidermis.

The moving-picture industry finds itself confronted by a problem closely related to this question of sunburn. The huge arc lamps used in the film studio, just like the sun, give out ultra-violet as well as visible light—the former comprising a very considerable proportion of the total. Hands and face get quickly accustomed to this, and immune to further burning just like the bronzed life-guard at the beach. But the eyeball is another proposition entirely. It is very sensitive to the ultra-violet burning, and it does not acquire immunity. *The burning of the eyeball by the ultra violet rays* is a form of conjunctivitis. It is curable, but during the cure the patient must not be further exposed, and the eye is weakened by the fact of having been afflicted. This malady appears so freely among motion-picture actors—stars and supers alike—that a name, "Kleig eyes," has been coined for it.

In response to the recent offer of one of the largest producing companies, to pay $5000 for a preventive measure that would not involve a complete overturn in the methods of film production, thousands of suggestions were submitted. A committee of scientists and practical motion-picture men considered these suggestions with the utmost care, and carried out a good deal of research and experiment in accordance with the more promising schemes put before them.

The experiments took two lines—medical and mechanical. There appears no hope for a positive medical preventive. A substance is known which, when put *in the eyes, counteracts the bad effect of the ultra-violet rays.* But with constant use this substance has a weakening effect upon the vision, and it must be used constantly, for the tears wash it out quickly. Besides, five hundred people cannot be depended upon to bathe their eyes, before each scene with any given substance—let alone one that is admitted to harm their eyes.

It is, of course, absurd to talk of glasses to screen the offending rays from the players' eyes. Many film people wear dark glasses with the utmost faithfulness while waiting about a set in which the lights are burning, but no star, and precious few extras, can wear glasses in the face of the camera.

This brings us to the proposition that the glasses be placed upon the lamps, screening out the damaging waves and letting the others through. The difficulty here is that glass is very far from 100 per cent transparent, at its best. Plain window glass reduces the photographic ray 30 per cent, ground glass 40 per cent, and *Florentine glass 50 per cent. If the camera man* sets up a screen for the ultra violet, it will therefore cut off so much of the rays that he needs in his business that he must use two lamps where before he used only one. He will then find that the two lamps with the screens will supply as much ultra violet to the set as one lamp without the protective glass. This applies with plain glass, colored glass of any sort would obviously make the matter even worse.

In view of all these considerations, it appears that the solution, if there be one, lies in the film. A film would be needed that would work as effectively and as fast in a subdued light as the present films work in the glare. The laboratory men of the film company carrying out the investigation are now experimenting with a new type of film, in the hope of meeting this requirement. Whether they are immediately successful or not, in this direction, appears to lie the only promise of relief for the film artist.

At present, two types of illuminant are employed in the motion picture studios, namely, *the mercury vapor tubes* and the flaming arcs. Both generate a very large percentage of ultra violet light which is highly actinic. The electric power consumed may run anywhere from 15 kilowatts to several hundred kilowatts for a single set.

So far, colored spectacles are the only means known to protect the eyes against the ultra-violet rays in the camera man's arc light; and these would hardly go on the film

Group of the new loud-speakers, based upon the principle of the electrostatic telephone

The "cathodophone" transmitter, acting through direct sound-wave pressure upon the ionization current, without any membranes, etc., as in the microphone

Long-Distance Concerts in Germany

Germany, which so far was deprived of the blessings of radio music, has at last enjoyed her first radio or rather "remote" concert, for those responsible for the demonstration found it—for purely practical reasons—more convenient to use a transmission line for this first exhibition of their scheme, installing the artists in another wing of the same building rather than at a far away radio station. Anyhow, this concert, which our Berlin correspondent had the good fortune to attend proved a conclusive demonstration of the possibilities of a decidedly *new arrangement* which it is hoped affords the definite solution of the loud-speaker problem.

However, even apart from the loud speaker, the scheme comprises a number of remarkable new apparatus, of which the more important are described in the following.

First, attention should be drawn to a novel microphone or *Cathodophone*, as the inventors, Joseph Massolle, Hans Vogt and Dr. J. Engl, have dubbed it, and which is based on the following principle. An incandescent rod, e. g., that of a Nernst lamp, ionizes the air surrounding it, i. e., makes it conductive. When a small anode tube fitted with an acoustic funnel, is introduced into this ionized air, the anode voltage being about two to three hundred volts, an ionization current will flow toward the anode the intensity of which is acted upon by any fluctuation in gas pressure in the neighborhood, e. g., by fluctuations set up by sound waves, caught in the funnel thus superimposing an alternating current corresponding to acoustic variations over the ionization current. The most remarkable feature of this alternating current is the absence of any mechanical links, membranes, etc. as in the case of the ordinary or contact microphone, and its being absolutely proportional to fluctuations in sound pressure. After being properly amplified it accordingly can be used for all purposes in connection with which a perfectly parallel variation of sound and electric waves is required.

The second piece of apparatus is a particular amplifier, in the construction of which all selective influences were eliminated, such as are usually inseparable from oscillatory circuits, having a period of their own within the range of sound frequencies. *This is a low frequency* three-tube amplifier, the coupling of the elements of which is effected without any self induction. It will amplify currents of an intensity not higher than, say, 000 000,1 ampere, such as the most sensitive telephone is barely able to perceive, to about 10 watts of vibrating energy all frequencies within the acoustic range, i. e., those varying from 50-25 000, being dealt with exactly in the same manner.

It will be readily understood that in order to solve this gigantic task special types of vacuum tubes had to be developed. In fact, the inventors have been successful in providing decidedly novel amplifier tubes, based on the use of mica, which possess a number of additional advantages.

The third apparatus designed by the inventors is a novel loud-speaker or statophone, as it is called, which effects an incomparably purer reproduction than any other type used for radio reception. It is based on the *principle of the electrostatic telephone, which old as it* is, has so far been absolutely neglected by electrical engineers, and which in the present case, proves capable of unsuspected possibilities.

The new telephone is made of metal and mica throughout and is about 30-40 centimeters in diameter. The stationary armature has for the sake of damping been subdivided the membrane being divided into several eccentric rings, so that any position of resonance as characteristic of other vibratory arrangements, is done away with. In fact, the new telephone within the range of frequency for which it was designed comprises all possible position, *i. e.*, no special position of resonance at all. There is thus within the acoustic scale no maximum and no material fluctuation in the intensity of reproduction.

The efficiency of the new electrostatic telephone is especially satisfactory, any iron and copper losses as well as losses due to stray currents, as inseparable from *the usual or magnetic type of telephone, being strictly* avoided.

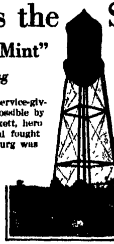
An amount of energy of only about three watts, such as developed by a few pocket lamps, proved sufficient to fill one of the largest music halls of Berlin with such a volume of sound as to enable the musical performance to be heard with practically natural intensity even from the remotest seats. The quality of renderings, of course, to some degree depends on the kind of instrument or in the case of song and recitation on the pitch of voice, but on the whole, was remarkably satisfactory and immensely superior to those effected by the usual type of loud speaker.

It is interesting to note that the apparatus here described has been used in connection with a new system of talking motion pictures, which attracted a good deal of attention in Germany. Indeed the main failing of talking pictures in the past has been the lack of realism, and this improved apparatus should prove a forward step.

When Water Power Paves the Streets

How the Town of Lawrenceburg Discovered a "Mint" on the Local Creek

By Luttell McClung



The water-tower which is filled by electric pumps

RARE indeed is the town or city that "coins money" for itself, yet this is just what the little community of Lawrenceburg, Tennessee, really does. The energy for such operation is generated by a large creek that flows close to the town, and the money coining equipment consists of a concrete dam, turbines, generators, transmission lines, electric pumps and water tower

Many communities have these facilities. Yet it has remained for little but enterprising Lawrenceburg to demonstrate that a publicly-owned and honestly-operated water power plant can liquidate its municipal debt, pay for public improvements, and at the same time supply the people with light heat, water and power at surprisingly low cost Lawrenceburg is small, and, naturally its water mint is small in proportion—less than 300 horsepower in fact But size has nothing to do with its significance Hundreds of towns and even a number of large cities could achieve the same results for their own treasuries and their own citizens, if they followed the Lawrenceburg method There is no longer any doubt that both principle and method are sound for everybody concerned.

Not only does Lawrenceburg secure its street lighting and water for fire protection without charge, but the profits from its municipal hydro-power plant have paid off the old floating debt of the community And, in addition, these profits pay for both street and sidewalk paving. There are no assessments and no taxes for paving not a penny do the people pay directly for any of these improvements. The writer does not know of any other community that quite matches this

Lawrenceburg is one place that has declared its independence of coal If not even a single pound of coal were ever brought into the town, its "white coal" would continue to turn the wheels of its industries, illuminate the streets and supply water as well as light and heat the homes. Today the municipality itself does not buy coal of any kind It never needs any

While this progressive town is giving its citizens such service and improving its streets without tax or levy, it is selling current for less than 4 cents a kilowatt hour It is selling water for 20 and 15 cents a thousand gallons And with this low cost service and with the profits that accrue there is still adequate allowance for the upkeep and operation of its hydro power plant and for the extension of service and interest on the money invested

"This little project of ours is a mint simply a mint," says E. P Nixon its superintendent "It goes right on working for the people at lowest possible cost and without any waste It is permanent and we are all very proud of it We have something to show visitors that other communities haven t got—but might have What would it cost if we went back to using coal? I don t know, I don't want to think about it—we would run so deep into debt"

This money-saving, money making, service-giving little municipal plant is made possible by Shoal Creek along which Davy Crockett, hero of the Alamo, once hunted bears and fought Indians. For many years Lawrenceburg was the home of this intrepid spirit, and it was from Lawrenceburg that he set forth for Texas and his last, and immortal, adventure in which he fell battling the Mexicans with the butt of his rifle

There is an 18-foot dam 204 feet long on Shoal Creek From the dam extends a tunnel 10 feet square through solid limestone to an outlet on the creek lower down. The 18-foot high dam and the 18-foot fall in the tunnel give a head of 30 feet The power-house and turbines are, of course, at the outlet of the flume through the rock. This little plant is located about three miles distant from town During the day the power is used by industries—hosiery mill, shuttle-block factory creamery, ice plant, flour mill, machine shops garages, printing offices, etc In the early part of the night the current, naturally, is taken by the homes. In the latter part of the night and in the early morning the energy from the turbines pumps water for industries and homes.

Thus the consumption of power is evenly distributed over the 24 hours and admirably balanced to meet domestic and factory needs. The water supply is a huge, clear spring just a short distance from town Here are installed two electrical pumps, operating on the power from the turbines two miles away and lifting the water into a large storage tank that gives necessary pressure for domestic and industrial uses and for fire protection

Left Power house of 300 horsepower, which supplies Lawrenceburg with power and light. *Right* Dam for the power house, measuring 18 feet high by 204 feet long

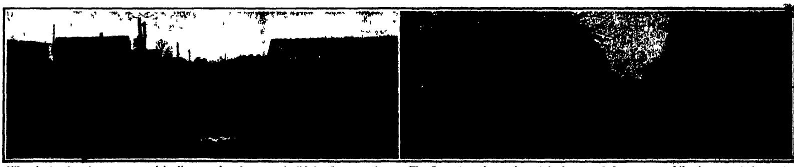
When the Lawrenceburg plant was first established as a municipal operation, it was not an immediate success. For some time there were not many buyers of current The town was in debt and the pessimists said that the cost of the plant only added to the debt Inducements were offered to establish the project on a paying basis. The town agreed to wire homes and business houses and to supply electrical equipment at cost This brought in a number of dependable contracts for power Then demand steadily increased. Today, Lawrenceburg home owners not only enjoy low-cost lighting but a number have electrical heaters, ranges and other appliances for heating water, washing clothes and dishes, sweeping, etc Yet their monthly bills for this service are low because the power is sold honestly by themselves to themselves Nobody secures the profits from this unusual enterprise but the citizens themselves.

In time profits began to accumulate and there was question of what to do with this surplus revenue. It was decided that it could best be spent in street paving And so this work was started. It is well under way and will continue until all the broad streets are paved and other municipal improvements made The town is growing rapidly and the streets will be extended and paved into new residential sections. The very fact that Lawrenceburg has cheap current for homes and industries has attracted many new residents.

As may be supposed, the time came when power demands were greater than the supply Now the town is going further down on the creek to build another dam This second municipally-owned operation will be interconnected with the first, and there will be sufficient power to take care of the new industries and residents. But the time will come when even this operation will not be sufficient for the growing population and new factories—growth caused directly by honest, efficient municipally owned hydro-power service. The people realize this and are now looking beyond their second plant They intend to go further away to a large power stream and there construct a dam whose energy will build a real city at Lawrenceburg They have realized that a community can be built anywhere if hydro-power is harnessed and distributed to the people for service and not for private profits.

The danger that has threatened several times is that of the plant falling into private or corporate hands, with the usual stocking and bonding that builds up continuous interest charges and gives opportunity for enormous profits to a few individuals. There are dozens of towns in that section of the country that are supplied by current generated from water-power But all except Lawrenceburg pay high prices for service and large and continuous profits to the corporations that are heavily capitalized and heavily bonded

Lawrenceburg has fought safely through this danger and the people now would not sell their little "water-mint" to anybody for any sum They not only want it for its continuous and direct benefits to themselves, but for the example it sets to other towns and cities located where hydro-power is available.



What hydroelectric power, municipally owned and operated, did for Lawrenceburg The first view shows the original state of the streets, while the second shows the present appearance of the residential streets

Barge load of houses en route across the Kanawha River

House-Moving by Ferry

SOMETHING different every day is almost certain to be the lot of the man who makes the moving of houses his profession. It is no longer a novel sight to see a large frame cottage traveling down the road or across the street but a trip across a river is not so ordinary an incident in the life of a residence. Yet twelve frame houses in Charleston, W. Va., have recently undergone this experience. In order to obviate the necessity for moving them up or down, blocking was built up to a height of forty feet on the barges that were to transfer them to the other side. The houses were then moved out upon this blocking quite in the ordinary fashion of moving houses, and after being ferried over the stream, they were similarly slipped upon their new foundations.

The houses occupied the site that is being cleared for the new State Capitol, and their owners saved a very comfortable sum by moving them to new locations as against the cost of rebuilding. Thirty two houses in all are being moved, but of these only twelve have been obliged to find new sites on the far side of the river.

A Machine for Sowing Seed by Hand

AMONG interesting German inventions of the post war period, few are of more direct practical application than the seed growing device which we illustrate. Sowing machines are for the most part inclined toward size and costliness, for the small land-owner or tenant farmer there has not been any very satisfactory alternative to hand sowing, with the irregularity of distribution that must necessarily accompany it. The sturdy agriculturist of our photograph, however, has only to hold his distributor steady with the one hand and grind slowly with the other to insure an even allotment of his seed until the supply in his bag is exhausted.

Hand-sowing of seed by use of a device that insures uniform distribution

The Rotary Plow

WHAT is plowing? Since thousands of years the farmer has been accustomed to regard the necessary annual loosening and remixing of the soil as being practicable on a large scale with one implement alone, the turnplow drawn by horses or power. Thus the word "plow" has come to denote an implement which is simply a combination of two soil-cutting knives and a moldboard whose warped form is designed to invert the ribbon of soil cut from the land by the vertical and the horizontal knives.

But plowing does not always have to be done in this orthodox manner. Acting on a wholly different principle from the old turnplow which, however fully perfected during the last few decades suffers from certain shortcomings that are fundamental, the rotary plow invented by Fletcher T. Hamshaw of Seattle, Wash., accomplishes the desired results, according to the claims of the inventor, in a better manner. In addition it performs at the single plowing operation all the equivalent work of the several customary seedbed fitting operations, such as rolling, disking, harrowing, pulverizing and, if desired, drilling in the seed as it passes.

An inspection of the photograph of the rotary plow is quite sure to leave the impression that it is a kind of tractor, an impression given by the appearance of its forward parts. But as it draws nothing it cannot be called a tractor. It is complete in itself; in fact, far from drawing any apparatus it is equipped with an extra rear wheel whose chief function is to hold the implement back so that the revolving drum bearing the soil-cutting knives or plows may properly do its work of chewing up the soil in progressive bites instead of simply running forward like any wheel without doing any plowing.

The entire implement, which weighs 6000 pounds, is driven by a 45-horsepower gasoline engine of the tractor type. The rotary drum bearing the 24 hardened steel shears is its fundamental part. This drum is caused by the engine to revolve at the rate of 132 revolutions per minute so that 53 shears strike the ground each second. From one to two inches of soil is bitten off by each shear while the machine progresses over the ground at the rate of about 3½ miles per hour.

The diameter of the big drum is 44 inches, a size required for efficient work if the plow is to penetrate to a depth of 18 inches. This great depth of plowing is one of the salient features of the new implement. It brings up at least six inches of subsoil that has never seen daylight, and it thus introduces not only a new seedbed of hitherto unused soil but a controversial subject. The belief has always been prevalent that subsoil was so lacking in humus that the farmer should be very cautious in bringing much of it to the surface at any single year's plowing. It was frequently stated during the war that the soil of France would prove to have been ruined by the action of high-explosive shells in turning up the subsoil from depths of several feet. It would be non-productive. But regardless of theory when the French farmer came to try crops on such soil, thus "asking the soil" instead of the theory, he discovered that the new yields were very much heavier than the old.

In the case of the rotary plow, which regularly plows to a depth of 13 inches and has penetrated to 18, check tests between soil thus plowed and that done with the turnplow have demonstrated that croppages have been more than doubled in some cases.

In milling the soil over, much as metal is cut away in the machine shop by the miller, it is very finely comminuted. This exposes a very large surface to the action of plant roots and favors very greatly the absorption of plant food. It also aids the aeration of the soil without which crops practically cease to grow. When fertilizer and trash have been left on the surface they are incorporated in a far more thorough manner than is possible by ordinary plowing, and to a far greater depth than is possible by repeated disking, giving a very uniform distribution from top to bottom.

The rotary plow is not intended for use in stony soil, where the blades are soon spoiled, but is at its best in the great prairies where they are rare. On these lands grain has been grown for many decades without plowing much below three or four inches and this has given the impression that the soil has been robbed of fertility. The new plow, however, is able to go deeper and bring up new farms, mixing them with the old so that no humus is lost and the soil consistency is little impaired.

There are vast areas of unreclaimed marshlands in the East where the soil is stoneless. Usually these are covered with a dense overgrowth of shrubbery, flag and other vegetation that is very hard to turn under with the common plow. These, with their roots, the rotary plow is claimed to handle with ease. About as severe a test as any plow can be put to is the breaking up of an old, well-established asparagus bed. These

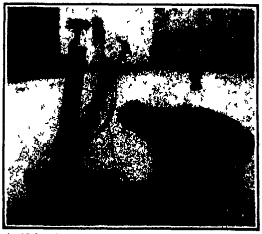
The rotary plow that converts virgin soil into seed bed in a single operation

roots are very large, very tough and they permeate the soil in all directions. The rotary plow makes short work of them slicing the matted roots into small pieces and leaving them in the soil to decay and provide plant food.

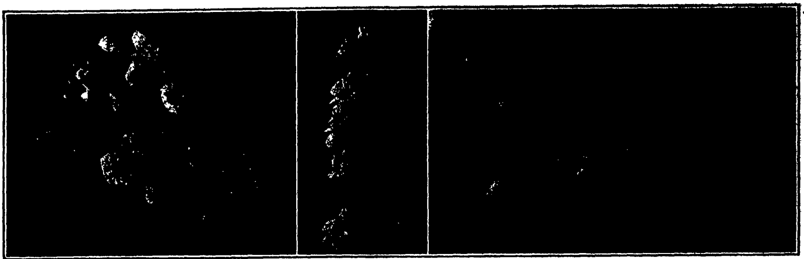
Thus it is seen that newer methods may be brought to bear on the one annual operation that for the average farmer is the most laborious of all the season's work, plowing—a task which has been in very much the same way since biblical times. It is very difficult to uproot a prejudice of this great age. Yet experience has shown that the American farmer is by no means slow to adopt new methods of doing things once they are proved to be easier and to do the work as well as the old methods. The ready acceptance of the farm tractor stands in proof of this contention. The rotary plow may result in such a change in farming as to eliminate the turnplow, just as the latter eliminated the crooked stick.

Making Lightning for the Films

PROBABLY most of our readers are sufficiently sophisticated to realize that, when the movie man needs a flash of lightning in his action he does not have to wait for a thunderstorm to get it. Probably few of them however realize how simple and cheap the production of film lightning is. The wooden stand used for the purpose which we illustrate, is wired just like an arc lamp. The two contact points are on the two upright arms—a single large carbon constituting the electrical member in the one case and several smaller ones in the other. By pulling a cord the two contacts are brought together and the circuit established and when they are released and the circuit broken, there is a momentary flashing arc. The spreading out of the arc effect over the several small carbons of the one contact is responsible for much of the realism of this brand of lightning.



Artificial lightning for the movies is produced with this simple arc machine



Left: Kalmia latifolia or broad-leafed laurel, which is sometimes mistaken for wintergreen. *Center:* Delphinum ajacis. *Right:* Atropa belladonna, the deadly nightshade. Three of its berries contain sufficient poison to cause violent symptoms

Poisonous Plants of the Garden

Danger Which Lurks in the Pretty Flowers and Berries Picked at Random

By Dr. E. Bade

IT IS an armed truce which exists between the plant and the animal kingdoms. Vegetarians, especially the more hoggish kinds, attack plants and voraciously gulp them down from leaf to stem. As a means of preservation against such willful and unnecessary wholesale destruction many ingenious protective devices are employed by the plant and of these the more important are corrosive liquids and poisons.

Not only those substances which, in infinitesimal quantities, endanger the animal organism fatally, but all those many chemical compounds which are injurious to the plant eating animals are included. These, it is true, only form a very small part of the known toxic substances. Certain plants secrete certain well defined poisons, which although they may be harmless to one animal, are intensely toxic to another species. Many plants are more or less protected by such secretions from total destruction through over voracious animals, but the toxin cannot be considered as a protective medium since the plant does not produce it for this special purpose. It is only a product of metabolism and that the plant has finally changed this substance chemically for its own protection can hardly be seriously considered although much can be said in the support of such a theory.

In all probability each flower has its own poison—in its broadest sense—of which we know nothing, nor which we can recognize. Grazing stock usually despise floral envelops but eat the leaves. On the other hand, they carefully leave certain plants severely alone, although they have no perceptible odor nor have they any special characteristic which would lead one to suspect hidden toxic properties. Something must be wrong with them, something must be veiled from our grosser senses but at any rate it is perceptible to the animal.

Plant poisons as built up by nature, chiefly consist of carbon hydrogen oxygen and often the inert nitrogen a substance which in itself is very inactive and sluggish but united with other elements gives us not only beneficial but also very harmful and dangerous compounds. Then, too sulfur may be present, as well as a few metals, the most important of which is potassium, but these are quite rare in occurrence. This building material is also used for the formation of the entire plant, from grasses to the mightiest of oaks. Certainly it is a marvelous power inherent in the plant which enables it to produce all those materials found in it, the various poisons themselves only being a tiny fraction of the existing compounds.

The action of the different types of poison on the organism are peculiarly distinctive. Each one has it own symptoms. Some only react when they come in direct contact with the blood vessels, being fatal in almost infinitesimal quantities. Others have no, or practically no power under such a condition. They are most vigorous when they reach the stomach, where they produce the most serious of disturbances.

Although poisonous animals are seldom mistaken for harmless creatures, such a definite classification cannot be given to the plants. In fact, a large number of them are similar to the most common of kitchen herbs and edible plants. Others, again produce fruit, which, in appearance, seem to be tasty and delicate, but in reality are most dangerous. Such headlines as "Poisonous mushrooms cause death," and "Children die eating poisonous berries" are only too often found in the daily papers.

No method is known by which the character of a poisonous mushroom can be determined. The only protection available is the personal picking of the wild species and the absolute irrefutable knowledge of the character of each individual mushroom picked. Formerly, two types of mushroom poisoning were differentiated one a narcotic and the other a digestive disturbance. Both symptoms often intermingle the effects taking place a few hours after eating. There are a few methods by which the toxic effects can be removed. In all probability, all poisonous species can be rendered edible by first digesting in vinegar and salt, then boiling for some time in water, and discarding the boiled water.

Edible mushrooms sometimes produce symptoms of mushroom poisoning, especially when they are not used in their fresh condition. Mushrooms decay rapidly when they are not prepared at once, and the product of decay somewhat resembles ptomaine. It is not at all necessary that such decay be accompanied by a softening of the tissues and a disagreeable odor.

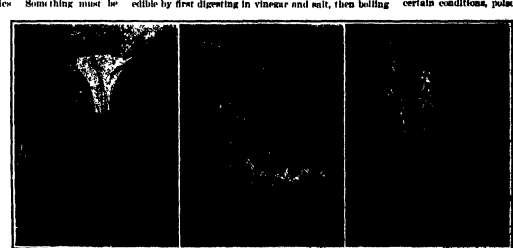
Far more numerous than mushroom poisoning is poisoning through berries. Children often eat those of *Atropa belladonna*, the deadly nightshade. Even three of these berries contain sufficient poison to cause violent symptoms. This alkaloid atropine slows the action of the heart and stops the action of the salivary glands. It also attacks the nervous system and causes violent delirium. The most characteristic symptom is its action on the pupils of the eye which it dilates.

The jimson weed or thorn apple, *Datura stramonium*, was introduced by gypsies who considered it their "personal" poison. Besides the toxic atropine, hyoscyamine, hyoscine and several other alkaloids are present. The latter two are found in still larger quantities in *Hyoscyamus niger*, the henbane, whose pale yellow flowers, profusely veined, appear in June and July. The entire plant is sticky and covered with hairs, and, despite a stupefying odor, is often mistaken for a kitchen herb.

Foxglove (*Digitalis purpurea*) and jimson weed poisoning occur but rarely. In the latter case an indirect poisoning may take place. Large edible snails (*Helix pomatia*) eat the leaves of the plant with impunity, but when these snails are eaten, poisoning occurs. In a similar way the honey gathered by bees from the broad-leaved laurel (*Kalmia latifolia*) is, under certain conditions, poisonous. Then, too, children often mistake the young shoots of this laurel for wintergreen (*Gaultheria procumbens*) and are poisoned.

The common nightshade, (*Solanum nigrum*), with its black toxic berries, which are often eaten by children, opens its small flowers during July, August and September. The symptoms are stupefaction, dizziness, loss of speech, cramps, and the entire body is convulsed. The pupils of the eye are dilated and death often occurs through a stroke.

In every case of poisoning a doctor must be called. In the meantime, until he arrives, it is advisable to give an emetic and tannin or a liquid containing tannin. Artificial respiration may be used to counteract a possible paralysis of the lungs.



Left: Datura stramonium, or jimson weed or thorn apple, which contains powerful alkaloid poisons. *Center:* Solanum nigrum, which has black toxic berries often eaten by children. *Right:* Digitalis purpurea, otherwise known as fox glove

Slipping Railroad Coaches to Save Time

THE conditions and requirements of railway travel vary in different countries in many respects, and to an extent that would surprise the uninitiated. A few words explaining the reason for the slipping of passenger coaches on English railroads may therefore not be amiss.

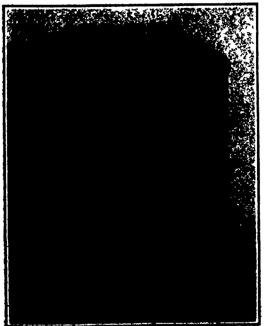
It sometimes happens, in the case of a long-distance, non-stop run to a certain destination, that a full train of cars is not required, in other words, that there is motive power to spare. It also happens that, while it may be expedient to maintain a certain service to other stations, either intermediate or on branch lines, traffic requirements would not warrant running separate trains long distances to such destinations, as frequently as is desirable.

The object of slipping coaches is therefore, to divide an express train, while traveling at full speed, into two portions in such a manner that while the front continues its journey unhindered, the remainder, under the braking control of a guard, can be slowed down so as to stop at a predetermined point, where it is taken in tow by another locomotive in waiting, thus saving some ten minutes loss of time otherwise entailed by stopping the whole train.

This method is employed by a number of English railroads, notably the Great Western, the Great Eastern and the North Western lines. It is effected so easily that passengers in the slipped portion of a train, alighting when it stops, have no idea that the locomotive with the front portion, is speeding on its journey several miles ahead

Before describing the mechanical details of the slipping system, it should be mentioned that the English method of coupling railroad vehicles is quite different to the automatic system employed in America One of our illustrations is that of the standard British form of coupling. At each end of every coach there is a draw bar ending in a hook, and through a hole in the shoulder of the hook a shackle is passed, from which depends a union screw with a screw block and lever At the other end of the union screw is another shackle To couple two coaches together, the lower shackle of one of these couplings is lifted and passed over the drawbar hook on the other coach The union screw is then tightened up by hand until the buffers of the two coaches are in firm contact.

There are several different types of slip couplings in use, of which it will be sufficient to describe those employed on the Great Western and Great Eastern railroads in England In these the drawbar is formed in two portions which are hinged in a vertical plane on a horizontal pin, so that when free the hook portion swings downward, but when fixed it serves exactly the same purpose as an ordinary drawbar hook It will be seen from our illustrations that the end of the movable portion of the hook is formed so that, when in use, it takes an inclined seating on the shoulder, the upper edge of the end lying horizontally and flush with a packing on top of the shoulder Round the latter is an inverted U strap secured to the shoulder so as to



End of car equipped for slip coupling. Note the link which engages with slip coupling shown in other views

leave a hole or slot above the end of the hook In this slot, a horizontal case-hardened locking bar is fitted, extending to the inside of the guard's van where it is pivoted to a hand lever, the upper end of which may either be held in position by a pin or secured by a spring catch in the slot of a quadrant

To couple up the vehicles, the lever is pulled forward, thus withdrawing the locking bar and allowing the hook to open out The ordinary coupling shackle of the other coach is then lifted into position, the hook is hinged back round it, and the locking bar is shot forward, thus effectively securing it

To slip a coach, the guard first closes the cocks in the brake pipes, and then pulls forward his lever, thereby releasing the hook which falls downward Immediately the shackle in the coupling of the other vehicle falls out, and the whole coupling swings downward, thus severing the connection completely so that the rear coaches begin to lag behind those in front, which continue their journey with unabated speed

The slip coupling should be at least as readily applicable to the American type of automatic coupler as to the English type

Take the case of the automatic coupler on vestibule coaches, operated by a lever under the coupling apparently it is only necessary to introduce a few bell crank and other levers, including an operator's lever in the guard's van similar to the English type, to render

Slip coupling, shown above, in the open position, with link released and out of picture

the slipping of coaches on American trains a very simple operation indeed And it is on its face a very profitable one It is indulged in so freely in England that, when one takes an express train from any of the large London terminals, it is a very essential thing to make quite certain that one is in a car destined for the point to which one's ticket reads. Failing this precaution, one is likely to find oneself prematurely shunted off the main line, or carried past the point at which one should have been shunted

Use of Kilocycles in Radio

THE Second National Radio Conference, which was held last March, introduced a method of designating radio waves, which is somewhat new to the radio public This is the use of frequency in kilocycles (abbreviated (kc) instead of wave length in meters. The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave length in meters. As a matter of fact, wave length is a somewhat artificial conception in the handling of radio apparatus and is one of the difficult things for the beginner to understand The frequency of the radio wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set

As often happens in technical matters, the idea of "kilocycles" is simpler than the forbidding aspect of the word suggests. "Kilo" means a thousand and "cycle" means one complete alternation The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing meters is that the necessary separation of the frequency of transmitting stations to prevent interference is the same, no matter what the frequency may be. This necessary separation is variable and

Slip coupling in use on great Eastern Railway in England, shown closed

quite misleading when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the amateurs will in the future work in a band of wave lengths from 150 to 200 meters, but this is a frequency band from 2000 to 1500 kilocycles. This is an enormously wider band when considered from the viewpoint of kilocycles than for example, the band having the same width in meters from 1000 to 1050 meters, which is 300 to 286 kilocycles. While it is possible to carry on 50 simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1000 and 1050 meters, because of the smaller range of kilocycles here

In accordance with the recommendation of the Second National Radio Conference the Department of Commerce and other Government departments will hereafter follow the practice of specifying in even values of kilocycles rather than meters. The conference recommended the practice of expressing wave frequency in kilocycles per second with wave length in meters in parentheses thereafter The relation between the two is very simple For approximate calculation to obtain kilocycles, divide 300 000 by the number of meters to obtain meters divide 300,000 by the number of kilocycles. For example 100 meters equals approximately 3000 kilocycles, 300 meters equal 1000 kilocycles, 1000 meters equal 300 kilocycles, 3000 meters equal 100 kilocycles A table which may be used for rapid and accurate conversion either from kilocycles to meters or meters to kilocycles may be obtained by addressing the U S Bureau of Standards, attention Radio Laboratory, Washington, D C

Types of Aeronautic Instruments

THE Bureau of Standards has just issued Technologic Paper No 237 on "Types of Aeronautic Instruments." Copies can be obtained from the Superintendent of Documents Government Printing Office, Washington, D C., at 20 cents each

This paper describes the various instruments ordinarily used on the modern aircraft and will be found useful to all those interested in the aeronautic instrument art The instruments considered in this paper are as follows Altitude instruments, including altimeters, barographs and statoscopes speed instruments, including air speed indicators, ground speed indicators and rate-of-climb indicators orientation instruments, such as compasses, turn indicators and inclinometers, engine instruments, among which may be mentioned tachometers which are used to indicate the number of revolutions of the propeller pressure gages, gasoline gages, gasoline flow indicators and thermometers and navigating instruments, including maps, dead reckoning instruments, astronomical instruments and the radio direction finder

Among the special instruments and accessories described in this paper are oxygen instruments, recording instruments, strut and gas temperature thermometers, the strut thermometers being used to indicate the temperature of the surrounding air while gas thermometers are employed on lighter-than-air craft to give the temperature of the gas in the bag. Other instruments described include clocks and watches which are carried on nearly all aircraft and which must be capable of withstanding shocks of landing and severe vibration, manometers and hydrogen leak detectors, employed entirely on lighter than air craft to control the pressure of gas in the bag and to indicate leakage

The paper is profusely illustrated with photographs of the latest types of aeronautic instruments.

The Wembley Park Stadium

Built in London, the Largest Sports Arena to Date, with a Capacity of 125,200 People

By P. J. Risdon

THANKS to the courtesy of the management, we have been enabled to compile from first hand information some interesting particulars of Wembley Park Stadium, the greatest stadium and sports arena in the world, which has recently been completed in London at a cost of $1,500,000

The arena and amphitheatre buildings, with their immense accommodation for spectators and players, occupy a total area of 12 acres The seating accommodation provides for 24,580 spectators under cover and a further 9700 in the open, the total seating and standing capacity being 125,201—50 per cent greater than 80,000 credited to the Roman Colosseum though many authorities believe it held nearer 50,000 than 80,000 In addition there is accommodation for the convenience and comfort of 1000 athletes, including dressing, massage and bath rooms, gymnasium fully equipped with modern apparatus, and a large recreation room with billiard and writing tables. Access to the grand stands and to all parts of the stadium is gained from a wide circulating corridor, wide enough for 24 persons abreast, with corridor gangways and double stairways at frequent intervals leading to all parts of the stadium The following is an interesting comparison with the Colosseum at Rome

	Colosseum	*Wembley Stadium*
Outside length	622 ft.	896 ft.
Outside breadth	528 ft.	695 ft.
Arena (full)	235 ft x 180 ft.	621 ft x 320 ft.
Arena (grass)		492 ft x 260 ft.
Football patch		360 ft x 240 ft.
Estimated spectator accommodation	50 000 to 80 000	125 200

The outer wall of the stadium, half a mile around is carried on 37 arches, each 45 feet high and 50 feet span The structure is built almost entirely of steel and concrete and comprises 40 miles of terracing Although there is little risk of fire, ample provision is made to cope with an outbreak On the north front, overlooking the exhibition grounds, are two concrete towers 106 feet high each surmounted by a reinforced concrete flagstaff

The arena of the stadium—the area occupied by the playing field and the running tracks—has been prepared under the supervision of Mr Charles Perry who has been responsible for the construction of all Olympic playing fields and tracks since the reorganization of the Olympic games in 1906 in Athens.

It was decided to deal with the stadium at Wembley in very much the same way as that at Stockholm had been treated, and that the foundation of clay should be so shaped as to form a natural drainage system To this end a fall was allowed for, from the center of the arena to the outside edge all round the playing field of at least six inches, to allow the water to run away

On the clay foundation, various grades of cinders and clinker ash were laid to a depth of ten inches, and over this again five inches of specially prepared soil was spread to form the natural bed of the turf

Wembley Park, before it was taken over by the exhibition authorities, had been occupied for 12 years by the Wembley Park Golf Club. In April, 1922, when the exhibition authorities took over the park from these owners, as many of the fairways and putting greens as could be spared by the contractors were railed off, and put under cultivation These greens were dressed, rolled and cut, and generally treated, in order to produce by September the very best turf possible On September 6 a large portion of the arena was ready for turfing, and the cutting and transferring of this turf was begun The turf was cut in dominoes, 18 inches by 12 inches, and 2½ inches thick and these were placed on flat skips and taken by a small gage railway into the stadium Here they were unloaded and relaid immediately The grass never ceased growing The work was so organized that the turf was laid almost as soon as it was cut, and arrangements were made by which, on each day, no more turf was cut than could be successfully laid on that day The turf laying was completed by October 6, and two weeks later, owing to the excellent way it had been knitting, the grass had to be cut The result is that there is now a football ground composed of a grass so tough, that it will withstand the wear and tear of a season's football and yet remain as green at the end of the season as at the beginning.

The live load test of the stadium by 1200 ex-service men, who rose and sat down suddenly *en masse*, marked time, swayed from left to right and backward and forward Readings of the effects were taken

General view of the Wembley Stadium along its longer axis. Over-all length 896 feet, breadth 695 feet. The arena, 621 feet by 320 feet, may be compared with the Colosseum, Rome, which is 235 feet by 180 feet. Total capacity, seated and standing, 125,200

The arena is 100 feet above sea level, and stands on the highest point within the exhibition ground. The sub-soil is heavy clay The system adopted, therefore, was to prepare the foundation of the arena so that there was a drop of six inches in the clay formation from the major axis of the stadium to the running track, and then, in addition, there was a drop at each end of the arena from the position at which the goal posts would be placed, toward the track.

There are two running tracks, one skirting the playing field being a circular quarter-mile lap, while the other gives a straight 220 yards sprint. The straight is made possible by tunneling under the west-end bank of the stadium, so that the runners will begin the distance out of sight, but will emerge from the 80-yard tunnel into the full view of the spectators. Some of the more recent sports grounds in America possess this feature, but until now there has been no stadium in Europe with a 220 yards straight

It is fully expected that the tracks will become the fastest running courses in the world, and that new records will be set up. In the "220 straight" the absence of corners or curves will be a great advantage to the athlete He will not need to bend in with the curve of the course, and again, the race will be more truly run because the serious disadvantage of not being ahead when the first corner is reached will be done away with

The tests of the stadium were very exhaustive The first stage, by means of dead loads, was of a rigorous character Various sections were selected and tested separately The area of the first section tested was 86 feet by 35 feet Five thousand bags of sand, each weighing one hundredweight, were placed on the seats, giving a total load of 250 tons. The seating arrangements of this section will accommodate 850 people whose total weight would be only about 60 tons. Thus a large margin of security was revealed by the tests, for the test load applied would have to be quadrupled before the structure would fail

The live load tests were carried out by 1200 selected ex-service men, employes of Messrs. Sir Robert McAlpine & Sons, who built the stadium In company formation, the men marched up to the grand staircase of the stadium to that section of the stands immediately behind the royal enclosure Here they engaged in various movements — rising quickly *en masse*, sitting quickly, marking time, swaying from left to right, and forward and backward, cheering and stampeding. These movements were repeated on other sections of the stands, and the chart readings taken by the engineers during the tests showed variations greatly below those anticipated when the plans were drawn.

Standard Boxes for Hosiery

THE textile section of the Bureau of Standards has nearly completed the development of standard boxes for packing hosiery This has resulted in the reduction of approximately 300 different sizes to about 85 standards. These standards have been made up in 10 sets, and actual packings will be made at the Bureau After this check determination, the project can be considered complete, and it is expected that it will result in the saving of a very large amount of money to the hosiery industry.

Two cars comprising the instruction train employed by a French railway for breaking in new men and perfecting old railway employes in their work

A Traveling School for Railway Men

IN solving the problem of breaking in new men into the ways and means of railroading, the Paris and Orleans railway of France has developed an ingenious traveling school, which forms the subject of the accompanying illustrations. This school consists of two instruction cars, permanently coupled together and provided with a telescopic vestibule so as to form a single unit. The cars contain a vast array of equipment for the handling of classes. One of the coaches is a typical French four-wheeled baggage car, while the other—an eight wheeled affair—is known as an American type car.

Perhaps the most obvious feature of the traveling railroad school is the large collection of working models. On one side of one of the coaches there are various valve and driving rod movements mounted in such a manner that they may be actuated by a crank. A few moments' study of one of these models will teach far more than many hours' study of diagrams and text. Then there are models of the various types of compressed-air brake systems, with some of the parts broken away to facilitate study.

Typical model of compressed air brake equipment, with some of the parts broken away to show the inner workings

In one of the cars, suspended from the ceiling by means of cables, there is a table with a complete lay out of miniature tracks switches and signalling system. This piece of equipment is employed to teach embryonic railway men the essentials of railroading. The miniature railway comprises four stations with double tracks, four stations with single track, many switches and cross-overs, and 137 various kinds of signals. The table is counterweighted in such a manner that when it is not required it can be pushed up toward the ceiling and out of the way. In fact the same idea is employed throughout so as to use the available space to the best possible advantage. Tables, hinged at one end can be folded down against the wall and out of the way when not in use.

The breaking in of new men on railroads, or any other public service enterprise where their unavoidable inefficiency would constitute a menace to the life of the patrons, is always a ticklish problem. It is one that cannot be avoided however and the French have made a very intelligent attack upon it.

Standardization of Wood Screws

AT least two systems of numbering wood screws to designate the diameter have been used in the past methods of measuring, lengths have been hopelessly at variance and the number of threads per inch for a given size has not been the same for different makes. All this confusion has been eliminated and the dimensions of wood screws made uniform throughout the United States as the result of a cooperative agreement among the manufacturers, the Bureau of Standards and the technical section on builders hardware of the Federal Specifications Board.

The system of numbering to be used henceforth is the same as that now employed in designating machine screw sizes, except that diameters above No 12 are also designated by numbers. This means for example that a No 10 wood screw will have the same diameter as a No 10 machine screw. Uniform methods of measuring diameter and length and uniform tolerances in these dimensions were adopted together with a standard angle for the under side of the heads of flat and oval head screws. The number of sizes of brass and steel screws manufactured as standard was reduced from 555 to 291 a reduction of 47 per cent, while at the same time retaining a sufficient variety for every need. This reduction should benefit the manufacturer, the dealer and the user.

Circular No 140 of the Bureau of Standards describing this work has just been issued and can be obtained from the Government Printing Office at Washington.

1.—Miniature railway system with switches and signals for giving students the rudiments of railroading. 2.—Two of the working models of driving and valve mechanisms of French locomotives. 3.—An instruction class. The tables here in use are hinged at the left-hand end, so that they may be folded down and out of the way. The miniature railway is now up near the ceiling, out of the way, being held there by the counterweighted cables which secure it in any position

Some of the equipment of the traveling railway schools which helps convert recruits into seasoned railroaders

When Wood Shrinks

What the Camera Has to Report Regarding the Changes Taking Place During Seasoning

By B. B. Borchers
Forest Products Laboratory Staff

THE motion picture camera and the microscope recently made the first moving picture ever filmed of just what happens to wood when it dries. For eighteen hours, regularly every two minutes a strong light flashed upon a drying bit of red oak and every time the light flashed the camera clicked. Set above a microscope focused on the small block of wood, the camera recorded each change as the wood gave up its moisture.

Dr. M. E. Diemer, photographer at the Forest Products Laboratory of the United States Forest Service, made the film, which is only one of a series he hopes some day will be made.

"Physicists have known in a general way that shrinking and swelling always accompany moisture changes in wood," said Dr. Diemer. "The film records graphically, continuously and in a few minutes just how wood reacts during the long period of seasoning."

The piece of red oak used in this movie was saturated with moisture at the beginning of the picture; at the end of eighteen hours it was almost dry. As the moisture evaporated, the camera recorded the changes in the surface of the red oak.

One showing of this film would convince anyone that wood must be seasoned carefully before it is fit to use. Pictures can be taken of each kind of useful wood, showing just what to expect when it seasons. For instance, a flat sawed red oak board that is twelve inches wide when it is green will be only eleven inches wide when it has seasoned or dried. The motion picture gives a clear idea of how and why this inevitable shrinkage occurs.

The red oak used for the motion picture film was small—about one inch square and a quarter of an inch thick—and therefore it dried rapidly enough so that the changes could be noted by the camera. Cinemicrography, Dr. Diemer calls the method by which he took these moving pictures of actions that can be seen only under the microscope.

The beginning of the film shows the cross section of red oak so magnified that the cell structure is plainly seen. After a time the moisture can be seen to disappear from the cell cavities as the wood dries.

When this free water has evaporated and the wood reaches what is known as the fiber saturation point, shrinkage begins. As the moisture leaves the cell walls they shrink and draw the wood structure together.

The cell cavities, which were round at the beginning, become long and oval because the shrinkage of oak, as of other woods, is considerably more tangentially than radially.

The film brings out strikingly the phenomenon of checking. A small crack appears on the surface. It rapidly lengthens and widens until it seems as though the wood would split completely apart. Then the crack gradually closes and finally becomes invisible.

Such cracks or checks however extend to only a limited depth and are a common occurrence in seasoning wood. The outside surface which is exposed naturally dries faster than the inside. As the wood shrinks when it loses moisture the outside tends to shrink first. The inside is still moist and expanded so that the surface is held from shrinking. The stress that develops cracks the surface of the wood. As the inner portion of the wood dries the stress is removed, the cracks gradually close up and the wood appears the same as before the checking occurred. Checks never actually "heal" up, however, but remain as a permanent source of weakness.

The method by which this picture was taken at the Forest Products Laboratory is not new, although this is the first time it has been used for a study of the shrinkage of wood. The wood is focused under a microscope with the camera above and exposure is automatically made by a make-and-break circuit that operates the shutter at the proper intervals.

To place a bit of wood under the lens and take moving pictures in this manner sounds easy, but Dr. Diemer had to overcome many complications. In the first place, the light necessary for exposures produced so much heat that the wood dried too rapidly. It case-hardened—became hard and baked on the surface. To overcome this, Dr. Diemer had the light flash only when an exposure was being made—he accomplished this by a circuit similar to the one which operated the shutter. The heat developed by these intermittent flashes was much less than when the light burned continuously, and the wood did not case-harden appreciably.

Dr. Diemer found that when the wood shrank in drying, even though the movement was only one one-hundredth of an inch, it threw the microscope out of focus. He overcame this trouble by putting a spring under the piece of wood to keep it snugly against the bands that held it in its proper position under the lens.

The same area of the wood, about a quarter of an inch in diameter, had to be kept under the microscope. As the piece began to shrink, the area being photographed moved, and a new area came into view under the microscope. Dr. Diemer remedied this by placing a pin in the center of the piece of wood and beneath it the wood shrank toward this pivot, and so tended to move into the exposed area instead of out of it, keeping always the same portion of the block in focus.

Engineers at the Forest Products Laboratory hope that this practical demonstration will be particularly helpful to those who are using dry kilns to season lumber. Various pictures can be made that will show clearly the harm done to the structure of wood by too rapid drying, poor circulation, and other careless practices that are so common. Presented with such vivid proofs of the harmful effect of wrong practices, the woodworking industries may take more interest in learning scientific methods of kiln operation as a result of these novel "cinemicrographs."

1 and 2—Fifteen hours of drying changes the appearance of a small red oak block. In the first photograph the cell cavities are almost round; they become elongated as the wood shrinks, which fact is clearly brought out in the second photograph. 3. Dr. M. E. Diemer adjusting his apparatus preparatory to taking motion pictures of the shrinkage of wood. The picture shows how the camera is placed above the microscope. Both camera and light are operated automatically at regular intervals. 4—Close-up view of the red oak block held firmly in place on the microscope stand. The condenser at the left concentrates the light on the block. 5 and 6. A "check" in drying wood. The second picture of this pair shows it almost "healed" again. This also shows how wood becomes lighter in color as it dries

Making the motion picture camera report the story of what happens to wood when it dries

New Cadmium-Gallium Lamp

THE production of light sources from which pure monochromatic light of various wave lengths and great intensity may be obtained is from a practical viewpoint of great importance in the field of optics.

During the past month, the Bureau of Standards has constructed an enclosed quartz vacuum lamp using an alloy of gallium and zinc, similar in many respects to the cadmium-gallium lamp previously designed. The design of the new lamp has been so perfected that the lamp operates quite satisfactorily with very little flickering, giving several intense lines, one red and several blue and green.

Preliminary experiments have been made in connection with the production of a thallium lamp but the results so far have not been entirely satisfactory owing to the high temperature at which it is necessary to run the lamp to prevent the thallium from depositing on the walls of the light space, thus covering up the arc.

The Attack Upon Diabetes

THE word diabetes is derived from two Greek words, dia and bainein, which mean literally to flow through. Diabetes is the disease, in which certain matter which should remain in the human body, flows out through the urine. It has long been known as an incurable disease, but recent developments have seemed to give some hope that a real cure for diabetes, if not already found, will be discovered in the near future.

There are two forms of diabetes. In one, which the physicians call diabetes mellitus or glycosuria, in other words sugar sickness, an excessive amount of sugar is found in the urine. In the other form just the quantity of urine is abnormally increased, but no sugar is found therein. For our purpose we need not consider this form of the disease. The carbohydrate food we eat is ultimately converted in the digestive tract of the body into a form of sugar, known as glucose. This substance is either burnt up and converted into energy and heat or else it is stored in the liver for future use. Whenever we move our muscles, whether they are voluntary like those of the arms or legs, or involuntary like those of the heart and diaphragm (the muscle which performs the operation of filling and emptying the lungs), glucose is consumed, actually burnt up. It is easy to see that it is a serious matter when this substance cannot be burnt in the body and is excreted in the urine without performing its proper function in the body. This is what makes diabetes such a dread disease.

Diabetes being a functional disease has been treated mainly up to the present time by strict regulation of the diet, so that it does not contain any sugar or starches. Diabetic persons use saccharine as a sweetening agent in the place of sugar. Saccharine is a coal tar product. Diabetes is a disease which flourishes in the cities. It may be called a disease of civilization, as it is practically unknown among uncivilized peoples. It is caused by too great a consumption of sugar, by over-eating, obesity, and by sedentary life. It is found at all ages, occurs about twice as often in males as in females and more frequently in blonds than in dark people. The wide distribution of the disease and the apparent ease with which people become afflicted with it and the practical impossibility of getting rid of it, once it is incurred, make the work that has been done within the past year to develop a remedy for diabetes of the greatest importance to every human being.

Insulin. What It Is and What It Can Do

It is about a year ago that a group of scientists in particular Drs. F. G. Banting and C. H. Best, working in the physiological laboratories of the University of Toronto, Canada, announced that they had discovered a preparation which possessed the marvelous property of lowering the sugar content of the blood of dogs, when it was injected into them by means of a hypodermic syringe. This discovery was epoch making in the history of medicine. The extract was made from the pancreas of animals, particularly the dog, rabbit and the unborn calf. The process of making the extract has been applied on a commercial scale and in this country there is at least one drug house of national importance that is ready to supply insulin in regular quantities, under the name of Iletin. The process of making the insulin extract is long and laborious. It involves considerable time, as many extractions and purifications must be made before a product of the proper purity and strength can be obtained. The product must be standardized so that the doctor will know just what quantity of the insulin to administer to his patient. The cost of the drug is explained by the intricacy of its manufacture.

The drug comes in the form of ampoules and must be administered hypodermically. When taken by the mouth it has no effect on the sugar content of the blood. Only the ordinary precautions when using the hypodermic needle, need be followed when making the insulin injections. The doses are injected three times a day, a half hour before meals starting with small amounts and gradually increasing the same until the urine of the patient shows no more sugar. Patients are easily taught how to use the needle themselves.

Insulin Not a Cure

The word cure, when applied to insulin must be used advisedly. Insulin is not a permanent cure of diabetes. In fact certain forms of diabetes do not respond to it at all, and those patients who are benefited by it must keep on taking the drug constantly. Otherwise the original condition recurs. The effect of insulin is to reduce the sugar content of the blood and it renders the diabetic system capable of assimilating carbohydrates, that is, the sugars and starches. Even while taking the insulin treatment the patient must be kept under a strict diet in which the relative proportions of carbohydrates and fats are properly fixed.

Glucokinin

Glycogen is what is known as animal starch. It is abundant in clams, oysters, yeast and mushrooms. It is found in the green leaves of lettuce beans and wheat and the bulb of the onion. It was found by another experimenter that these materials contain a substance which helps the diabetic system, the system in which the pancreas is not functioning properly to burn sugar. The new insulin is called glucokinin. It has been established that the pancreas takes the raw materials furnished by these foods and makes "insulin," that is, sugar burning substance, to suit itself.

Intarvin

Another aid to sugar combustion is the substance called intarvin. This was developed in the laboratories of Columbia University under the direction of Prof. Ralph H. McKee. Intarvin is also a remedy for diabetes. It is in the form of an artificial fat. Its literal meaning is intermediate fat and it is the first true oleomargarine ever produced. Intarvin is made from margaric acid and is essentially glyceryl margarate. This substance has been used on diabetic patients with success. The fat, which is of white creamy color, odorless and tasteless, is absorbed by the diabetic system to about 90 per cent and seems to satisfy the hungry craving for fat that diabetics have. The results that have been obtained with this substance have been so promising that it hoped that diabetic patients of all kinds will be benefited by treatment with this medicament. It must be emphasized that a choice between the several treatments here outlined can be made only by a physician—perhaps only by a specialist—after careful diagnosis.

Relief, Not Cure

In conclusion it must be emphasized again that these different medicaments are not absolute cures of diabetes. When they are effective on the diabetic they enable him to live a more normal existence and prevent the development of complications which usually set in at some time or other in every diabetic sufferer. They make life more worth while living but they do not do away with the necessity of careful dieting and hygienic living. The patient must take the medicament indefinitely, at least that is how the treatment appears today. Whether or not a permanent cure for diabetes will be worked out from further investigation and experiment along the same lines, only the future can tell. Nevertheless the discovery of insulin and the other diabetes medicaments has given great impetus to further work along these lines to alleviate the sufferings of human beings from a disease, known at least for five centuries, but only within the past year actually remedied in any marked degree. And perhaps they point the way toward discovery of an actual cure.

Chemistry by Court Order

CONSIDERABLE interest has been manifested the past few weeks in the trial going on in the Federal Court in Wilmington, Delaware, in which the Government is trying to upset the sale by the Alien Property Custodian to the Chemical Foundation, Inc., of 4800 patents seized from the Germans during the war. The value of these patents has been put at a very large figure by the Government, and the opposing side has contended that their value is but nominal. It has been claimed that the practice of the Germans was to give very few details of the actual manufacturing methods in the patents that they took out in this and other countries, with a view to hiding the secrets of the manufacturing processes. Only the essential principles of the various processes were described, and it has been generally held that it is impossible to prepare many of the complex chemicals, drugs, dyes and perfumes from the information that can be gleaned from the patent specifications.

Certain experience has demonstrated the truth of this statement. Many German patents, which have been read by the writer, contain but very little information of practical value, which can be used in manufacturing the article forming the subject of the patent. While in some case details may be given and while the information may be sufficiently accurate to serve as a basis of a manufacturing process, in the actual operation of the process difficulties are always encountered which are not in any way described in the patent and which the investigator must overcome through his own ingenuity. It is often these very difficulties which are the essential features of the process and not the details which are described in the specifications.

The Court, in order to decide the value of the patent on cinchophen, ordered a chemist to make a test of the same by carrying out the instructions given therein in a laboratory experiment. There was so much contradictory evidence given regarding the value of the patent that it was considered best to have an actual experimental test made, which it was hoped would settle the question conclusively.

The experiment was made by Dr. Freedman in the laboratory of Swarthmore University at Swarthmore, Pa., and was closely watched by experts and deputy marshals. It lasted 26½ hours without interruption. Cinchophen was produced in the experiment, but, as the experimenter himself stated, in an unmarketable state. Two experiments in all were made and in one of them the experimenter made a slight deviation from the instructions given in the patent by pouring in two constituents, one after the other instead of simultaneously, but rapidly enough so that their action was practically simultaneous. In the first experiment the yield was 29.6 per cent of the theoretical but the product was too impure to be of any commercial value. It is possible to purify the mass so as to obtain a higher grade product. However the yield is too small to make the process of any commercial value. In the second experiment the yield was 14.3 per cent of higher grade product. A large amount of tarry matter was obtained which it was claimed could be purified to an extent permitting a larger yield and therefore nearer to commercial standard.

The sum total of the test seemed to be that the information contained in the patent was sufficient for preparing cinchophen, but the product obtained was not commercially feasible because of the small yield. A large mass of tarry matters were also obtained from which it may be possible to prepare more cinchophen, but nothing was mentioned regarding this in the patent. Here again it appears as if the real secret of the process has been hidden, that the particular detail which is crucial in determining the practicality of the process was not disclosed in the patent specifications. Sure enough, cinchophen can be made by the process, but a commercial product can only be obtained when the residues are worked up so that a satisfactory yield is secured. This is typical of most German patents, for in their patents, particularly the chemical patents, the Germans were not eager to give any information of value to competitors, or possible competitors, while they were anxious enough to secure patent protection.

The Lowest Temperature Yet Reached

THE Bureau of Standards, Washington, D. C., recently announced that the nearest approach to the absolute zero temperature which has yet been attained has been recently achieved by Professor H. Kamerlingh Onnes, of the University of Leyden, Holland. The record temperature of 272.18 below zero Centigrade, or, as the physicists express it .82 degrees absolute, was reached by the Dutch scientist in an unsuccessful attempt to solidify liquid helium. The temperature is equal to approximately 458 degrees below zero Fahrenheit. At this temperature the liquid helium showed absolutely no tendency to solidify, according to the report of Dr. Onnes, who expresses the opinion that helium may remain a liquid even at the absolute zero.

This temperature, 273 degrees below zero Centigrade, denotes the entire absence of heat, or, expressed in more scientific language, the entire absence of atomic or molecular motion.

Every gas has been both liquefied and solidified except helium which has never been reduced to the solid state in spite of years of effort. Dr. Onnes in his recent attempt, evaporated the liquid helium in the most perfect vacuum attainable, the pressure at the surface of the liquid being only thirteen thousandths of a millimeter of mercury, or about one sixty five thousandth of an atmosphere. A battery of twelve glass and six iron Langmuir vacuum pumps connected in parallel was used to obtain this result. The previous attempts to solidify helium having produced a temperature of 1.05 degrees absolute, Dr. Onnes undertook his latest attempt with the utmost refinement of technique and he was successful in getting the lowest temperature ever produced by man.

Reaching Upward With Concrete

How the Twelve-Story Limit Set on Concrete Buildings Has Been Discarded by Enterprising Architects

By Norman M Stineman

BACK in 1902 work was started on a sixteen story reinforced concrete office building in Cincinnati, known as the Ingalls Building This was the biggest single step in reinforced concrete construction up to that time. To some it may seem strange that architects and structural engineers did not follow up the precedent established by this unusual building, but continued to design tall buildings by older methods Lack of knowledge as to *how* to design this new material, reinforced concrete, naturally was at the bottom of the whole thing It was much less embarrassing to an architect to argue his client away from reinforced concrete than to admit that he did not know how to deal with it in the design of a large building

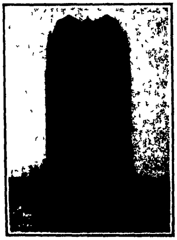
By 1908 the theory of the design of reinforced concrete structures had become quite well established but in the meantime an erroneous idea concerning the practicable height limit of reinforced concrete buildings became well rooted It was said that a height of twelve stories was about the economic limit, because in higher structures the lower-story columns would be very large and would occupy too much valuable space Perhaps not one architect or structural engineer or writer out of a hundred who made this statement had actually tested out its truth or falsity by independent investigations of his own But, at any rate, no more Ingalls buildings appeared for many years to follow

Arcade Building, St. Louis: 17 stories, completed in 1917

It was not until the prohibitive war prices of structural steel made the use of other materials imperative that designers of tall buildings again turned to reinforced concrete structural frames They soon discovered that by using an extra rich mixture of concrete for the columns in the lower stories, such as 1 1 2 or 1 1½ 3, and reinforcing the columns with both vertical steel bars and spiral steel hooping they could design reinforced concrete columns that were no larger and in some instances not as large, as encased structural steel columns in the same position

One of the most conspicuous results of these later investigations is the Arcade Building in St Louis, a reinforced concrete office building having seventeen stories above the sidewalk and two stories below This structure, completed in 1917, greatly stimulated the interest of builders in the possibilities of reinforced concrete for very tall structures, so that the Arcade Building did not long hold its record as the tallest reinforced concrete building in the world.

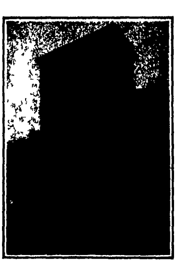
It was superseded in 1921 by the Hide and Leather Building in New York City, an eighteen-story office building having not only a reinforced concrete structural frame, but also an exterior facing of a special mixture of concrete



Medical Arts Building, Dallas; 19 stories, completed in 1923

Not to be outdone, Dallas, Texas, came forward with a nineteen story reinforced concrete office building known as the Medical Arts Building completed very early in 1923 It has supplanted the Hide and Leather Building as the tallest reinforced concrete building in existence

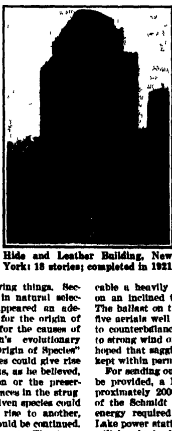
And now comes a story from Dayton, Ohio, to the effect that the new twenty-one-story addition to the U B Building in that city will have a reinforced concrete structural frame, from which it appears that Dallas will enjoy its present distinction for a limited time only The Dayton structure, for which the contract was awarded early in 1923, will have a ground area of 99 by 129 feet for the first fifteen stories, while the upper six stories will be fifty feet square It will be 276 feet high from the first floor level to the top of the building. It will involve no outstanding problems of design, and there seems no reason to suppose that it will mark a permanent limit to the height of buildings of this sort.



Ingalls Building, Cincinnati: 16 stories; completed in 1903

The Fact, the Course, and the Causes of Organic Evolution

WE may distinguish between (1) the fact of evolution, as representing the historical series of events, (2) the course followed in evolution, for instance, whether the land vertebrates arose from fish like ancestors, birds from reptiles, or the like, and (3) the causes of evolution or what made and makes it happen These three aspects, like those in the voyage of a ship, are separate through related items They must be constantly distinguished, if there is to be any clear thinking on this matter The historical fact of evolution seems attested by overwhelming evidence Science has nothing to conceal, it stands "strong in the strength of demonstrable facts," and invites you to view the evidence The course pursued by evolution is known broadly in many instances, but in the nature of the case the evidence is limited, and many of the steps will always remain uncertain, without, however, a calling in question of the historic fact The causes of evolution present the most difficult problem of all and the one regarding which we know the least. The recent strictures of Professor Bateson, which have been exploited by anti-evolutionists, were directed wholly at current explanations of evolutionary causation and the course of evolution He affirmed his belief in the historic fact when he said "Our faith in evolution is unshaken"—meaning by "faith," of course, a reasonable belief resting upon evidence



Hide and Leather Building, New York: 18 stories; completed in 1921

With this distinction between fact course and causes clearly in mind, the significance of Darwin's work in the history of biological thought can be understood. Darwin's accomplishment was two-fold In the first place, he established organic evolution as the only reasonable explanation of the past history of living things. Secondly, he offered, in natural selection, what then appeared an adequate explanation for the origin of species and hence for the causes of evolution. Darwin's evolutionary argument in his "Origin of Species" was that one species could give rise to another by means, as he believed, of natural selection or the preservation of favored races in the struggle for life If a given species could be shown to give rise to another, the same process could be continued. No limit could be set. The types thus produced could depart indefinitely from the parent form. Once the mutability of species be admitted, the only reasonable conclusion is that evolution has taken place His argument was supported by an immense collection of facts along observational and experimental lines. The total result was overwhelming.

The importance of Darwin's work in the history of scientific thought is that it convinced science of the truth of organic evolution and proposed a then plausible theory of evolutionary causation. Since Darwin's time, evolution as the historic fact has received confirmation on every hand. It is now regarded by competent scientists as the only rational explanation of an overwhelming mass of facts. Its strength lies in the extent to which it gives meaning to so many phenomena that would be meaningless without such an hypothesis. But the case of natural selection is far different. Of recent years, this theory of the causes of evolution has suffered a decline No further hypothesis, however, has completely displaced it It remains the most satisfactory explanation of the origin of adaptations, although its all-sufficiency is no longer accepted. As a result of this situation, there has been much discussion among scientists regarding the adequacy of what is often referred to as the Darwinian Theory, meaning natural selection. In condemning selection as an inadequate explanation of the problem, biologists have often seemed to condemn evolution itself It is not strange that the layman, for whom Darwinism and evolution are synonymous terms, believes that evolution has been rejected when he hears that belief in Darwinism is on the wane. He does not understand that what is thus meant by Darwinism is not the historic fact of evolution, but the proposed cause of evolution—natural selection —*Abstract from article by W C Curtis of the University of Missouri, in School and Society for April 14, 1923*

Germany Builds New Super Radio Station

AFTER the completion of the new wireless station, which the C Lorenz Company is now constructing in the Upper Bavarian Alps, Germany will have the most powerful and best equipped radio central in the world At first it will be devoted to experiments on a large scale, but later it will be operated by the C Lorenz Company, under a charter by the government, for commercial and governmental purposes.

One of the remarkable features of the new super radio station, which is located in a shallow valley between the Herzogstand (1732 m) and the Stein, one of the foot hills which rises above the Kochel Lake to a height of 940 m., is the manner in which the antennae are placed From the top of the Stein five aerial cables are stretched in fan fashion to five anchor points at the top of the Herzogstand, at an average height of 300 m above the station building. The combined length of the five cables is about 2½ km. To prevent excessive strain on the aerials by wind or sleet, the insulated ends of the antennae are attached to a powerful single cable which passes over a pulley at the highest point of the Stein To the lower end of this cable a heavily weighted car is fastened, which rests on an inclined track on the farther slope of the hill The ballast on the car is sufficiently heavy to keep the five aerials well stretched under normal conditions and to counterbalance their weight when they are exposed to strong wind or are coated with ice In this way it is hoped that sagging of the antennae will at all times be kept within permissible limits.

For sending out electro-magnetic waves two units will be provided, a Poulsen-Lorenz arc-light sender of approximately 2000 kw and a high-frequency generator of the Schmidt type of equal capacity The electrical energy required will be obtained from the Walchen Lake power station nearby The desired high frequency will be obtained either directly from the generator or by a frequency transformer as at Nauen. As the equipment described will render it possible to make, for the first time, a comparative test of the two methods of sending, the result of the contemplated tests is awaited with great interest by radio experts in all parts of the world.

Waterproofing Cloth by Electrical and Chemical Action

ORIGINALLY there were two general methods of rendering fabrics resistant to water. The mechanical process of impregnating the cloth with rubber, resins, waxes or gums makes the fabric not only waterproof but airproof as well. Such fabrics are non-ventilating, whereas in most applications air circulation through them is essential. Chemical impregnation of the cloth with a coating which is insoluble in water, while meeting this difficulty, is open to the objection that all such coatings known are insoluble only up to a certain point, and will quickly disappear on vigorous washing such as is ordinarily conducted in the household and the laundry, while such fabrics cannot be dry-cleaned, the aluminum soap which constitutes the waterproof coating, being soluble in the benzene of the dry-cleaner's soap.

Numerous efforts had been made to avoid both horns of this dilemma by the development of an electrolytic waterproofing process of some sort, but none of these processes had reached a commercial development. In 1907 this phase of the subject came to the attention of Mr Alfred O Tate, a Rhode Island manufacturer. Mr Tate had been private secretary to Edison in the early eighties, at a time when the dean of inventors was working with a telephone receiver consisting of a chalk cylinder, moistened with a chemical solution and revolved by a motor. Under the variations of the incoming current the electro-osmotic properties of this cylinder underwent local variations, and it was possible to utilize these variations in reproducing the sound which had been impressed upon the current at the sending end. The device, however, was much too complicated for extensive development, and was replaced in due time, by the present receiver. It is, deservedly, the least well known of Mr Edison's inventions but it is of interest on its own grounds. In particular, Mr Tate's recollection of the work done with it brought him to realize that the principle involved in the waterproofing of fabrics, not merely by coating them with a water-resistant film on the surface, but by causing the water-repellant agents to penetrate into the very internal structure of the fibers themselves, was one of electro-osmosis, just as in the case of the chalk telephone receiver.

The essential features of Mr Tate's first waterproofing machine, developed in 1908, have been retained in all the subsequent improved models. There is the graphite electrode, the cathode over which a solution of aluminum acetate is permitted to flow, an aluminum anode, and a heavy woolen pad completely enveloping the latter—a distinctive characteristic of the invention, making it possible to attain an evenly distributed waterproofing.

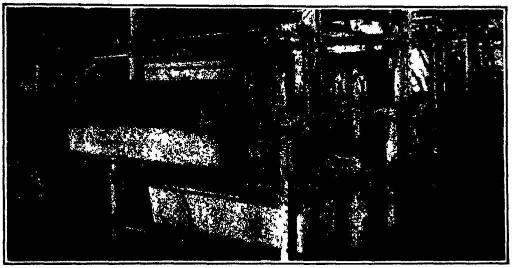
Laid aside for several years, the idea was picked up again after the outbreak of the war, and a second and third machine produced in 1915 and 1916. The latter was installed in Montreal in October, 1916, and used for waterproofing the fabric used in the Canadian aviation uniforms. On a military basis the machine was satisfactory, but its slow speed of operation—one yard of cloth per minute—made it plainly useless on a normal commercial basis. The controlling factor was seen to be the time of contact between cloth and electrodes, and to speed up the travel of the cloth without shortening this time of contact, the roll electrode was abandoned for the plate. This change led to the present type of machine, in successful commercial use today at the Tate plant in Cranston, R I. This plant has a waterproofing capacity of about 30,000,000 yards per annum.

Wool and silk fabrics are waterproofed on a machine with two sets of electrodes, cotton fabrics on one with four sets. The extra electrodes are necessitated by the structure of the cotton fiber, less easily penetrated by the chemicals than the wool or silk. The cloth passes first through a bath of sodium oleate, a very dilute solution being used. The fabric dips into the bath in an endless band, the excess solution being squeezed out as it passes between hard rubber rolls. The treatment is repeated, when the cloth is ready for the electrodes. So far as the chemicals used in this and later steps are concerned, the process is identical with the unsatisfactory ones which it is intended to supersede, the difference lies in the more thorough penetration of the material under the electrolytic action than under ordinary physical contact.

The electrodes are arranged vertically. The anode is built of aluminum bars, one above another and bolted together in a suitable frame, over which the woolen pad mentioned above is secured. The cathode is also vertical, and consists of graphite bars, fitted loosely into metal guides and held in position by springs, which allow a delicate regulation of the pressure against the cloth as it moves through the machine. This makes it possible to vary the pressure according to the character of the fabric being treated, and to pass a seam through the machine without stopping the apparatus. Each graphite bar is provided with a feed trough, extending the width of the bar and perforated at the bottom with small openings. The solution of aluminum acetate is fed to these troughs continually and trickles down through the perforations, wetting the cloth thoroughly and making it a conductor of the current, which passes from the graphite cathode through the cloth to the positive aluminum electrode.

The essential feature is the simplicity and the ease with which the treatment of the cloth is effected. The cloth takes but little time to pass through the machine, and it is really remarkable to observe how much its properties are changed by this short treatment. An ordinary piece of printed calico, which absorbs water like a sponge before treatment, sheds it like the back of a duck after treatment. Under ordinary pressure the water will absolutely not penetrate into the fibers

(Continued on page 290)



Electrolytic waterproofing and converting machine of the plate type which waterproofs fabrics of various kinds

An Air Washer for the Automobile

IN any engine, no matter what the service in which it is used, the chief cause of wear of pistons, rings and cylinder bores is the dust drawn in with the air supply. Furthermore, such dust in almost all cases comprises well over half of the solid matter or "carbon deposit" that accumulates in the combustion spaces.

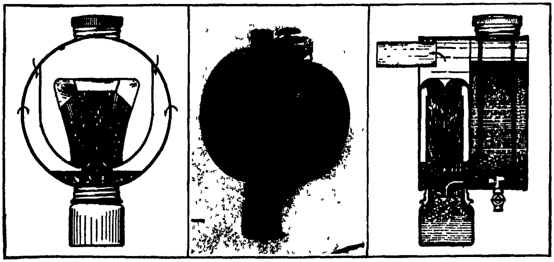
Practically complete removal of dust from the air is accomplished by simple means and in small space in the novel air washer shown herewith, in which the air is caused to pass through and become thoroughly mixed with a fine water spray. During this mixing the water gets possession of the dust, and retains it. After the water spray treatment, all liquid water is removed from the air, and the latter passes on to the engine thoroughly cleansed and somewhat humidified.

Tests show cleaning efficiencies never less than 97 per cent, with the engine idling. And as the air flow is increased the cleaning efficiency always increases. In making such tests only the finest and most impalpable dust obtainable has been employed so it is claimed.

Everyone is familiar with the greater smoothness and sweetness of the engine and its particularly "live" feel, in evening and night running. This results from the in general greater relative humidities and lower air temperatures after sundown as compared with those earlier in the day. Use of the automobile air washer results continuously in just such a condition of the air—somewhat lower temperatures and an increased relative humidity.

In the case of an engine that "pinks" readily, it is a certainty that use of the air washer will eliminate the pinking and will, therefore, cause an increase in the power delivery.

To insure a clean air supply, having a considerable amount of water vapor in it, it is only necessary to keep the washer supplied with water. The one and one-quarter-inch washer (suitable for use with all engines having one inch or one and one-quarter-inch carburetors) has a water supply capacity of one gallon, which supply is sufficient for from 500 to 1000 miles of running.



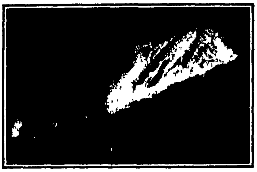
Air washer for the automobile and tractor engine, showing the method of automatically controlling the water supply to the washing chamber, and the courses followed by both air and water

The high cleaning efficiency of the automobile air washer is the result of the very intimate contact between the water and the air, and is somewhat contributed to by the fact that none of the dirty water passes out of the washer with the air. The finely sprayed water is completely separated from the air, after it takes on the dust, and for this reason the rates of water consumption are very low and are wholly accounted for by the evaporation. At the same time, accumulation of dirt in the washer has no effect upon the cleaning efficiency, nor does it cause the slightest increase in the pressure drop through the washer.

Make-Believe Lightning

Investigating Lightning Voltages in the Laboratory to Solve Lightning Arrester Problems

By F W Peek, Jr.
General Electric High-Voltage Engineering Laboratory



Sixty-cycle arc caused by the flashing over of high-voltage current

IN STUDYING the effects of lightning on transmission lines and on such apparatus as transformers and lightning arresters, it is important to have facilities for producing lightning voltages in the laboratory closely approximating those occurring in practice

An investigation of the lightning voltages induced on transmission lines has shown that during any storm many discharges take place on gaps set for lower voltages. The discharges become less and less frequent for the higher settings, and finally very few are found that exceed about 400 K V, or 400,000 volts. However, higher voltages do occur occasionally Another check on the voltage is the fact that insulator strings of seven or eight units rarely flash over during lightning storms. Lightning voltages or impulses are known to be of very steep wave front, which has the effect of increasing the voltages across an insulator or other apparatus at the rate of millions of volts per second.

A few years ago a 200-K V or 200 000-volt impulse or lightning generator was built to give lightning voltages of predetermined characteristics The time lag of various gaps was carefully measured and the term "impulse ratio" resulted. This generator has been added to from time to time as higher exciting voltages have become available An increase to almost 750 K V or 750,000 volts was made in 1916, while within the last year an increase to approximately two million volts has been made

It is not the intention to give details of the apparatus here since these data may be obtained from technical reports now available Briefly, the voltage is obtained by charging a large condenser to the desired voltage and discharging it through a known inductance and resistance Standard step-up transformers are used in sufficient number to obtain the desired voltage for charging the condensers. The result is a single lightning impulse of great power

In the lightning tests described in this article the voltages were applied at a rating of 50 million million volts per second The power may be of the order of millions of kilowatts The time of application is measured in microseconds (millionth of a second) This type of discharge must not be confused with the high frequency obtained from an oscillator In the lightning generator the discharge of energy is so rapid that the resultant spark is "explosive," and is accompanied with a loud sharp report or crack

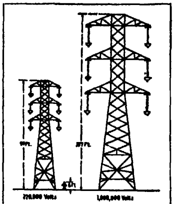
By means of the high voltages obtainable in the General Electric High Voltage Engineering Laboratory at Pittsfield Mass. it has been possible to learn much regarding high tension insulators. One of the problems that has been solved is whether lightning voltages will clear a shielded insulator string, just as will a 60-cycle spark-over Heretofore, impulse voltages sufficiently high to spark over a string have not been available, but photographs made of the tests indicate that the impulse goes to the shield and clears the string These tests are conducted in the dark, so that the camera may record the results. The photographs show the sparks that last less than a millionth of a second Other tests have shown how readily a lightning spark will clear the insulator string in a heavy rain. The insulator shield does not reduce the lightning spark-over voltage, nor does the rain. In the case of photographs of the wet test of insulators, made at a speed greater than one-millionth second, the illuminated rain drops appear stationary in space

Other practical investigations similar to those mentioned are being carried out in this unique laboratory Space does not permit full details, but we may mention a few of them, such as propagation of lightning on transmission lines, protective value of lightning arresters, effect on insulations, value of ground wires, choke coils, etc The lightning generator is also of great value in theoretical work. Indeed, *one of the spectacular* phases of the work has been the simulation of actual lightning striking a miniature church and houses, as shown in one of the accompanying illustrations.

The High Voltage Engineering Laboratory at Pittsfield is equipped with the apparatus necessary to carry on the problems of pure and applied research, as well as the more immediate developmental problems. The first essential of such a laboratory is plenty of free space A single example will make this apparent During a recent investigation sparks over eighteen feet in length were obtained A visitor's gallery is provided so that the sparks may be observed in safety

It is possible to make this whole laboratory dark in a few minutes. A smaller dark room is available for tests up to 300 K.V or 300,000 volts. The whole building is of substantial brick construction and kept at practically constant temperature inside Apparatus is available for studying the effects of such weather conditions as heat and cold, and rain and dew formation on insulators. Special measuring instruments are also available. As an example, spheres forty inches in diameter are necessary to measure the very high voltages.

In conclusion, it may not be out of place to discuss just what are the possible uses of a million volts in practical transmission. The conductor for such high voltage would be about one-half inch in diameter. If it is assumed that this is a hollow tube with copper equivalent to a one-inch rod, it is possible to transmit 3,000,000 kilowatts a thousand miles with about 12 per cent loss and a million volts at each end. If five-inch tubes were used there would be very little loss in fair weather, but during a rainstorm the loss would be of *the order of 1000 kilowatts per mile.* An approximate idea of the size of a 1000-K.V or 1,000,000-volt tower, compared with a 200-K.V tower, is given in the accompanying sketch.



Comparison of present 220-000-volt transmission tower with probable 1,000,000-volt tower

The striking fact that these figures bring out is the large amount of power necessary to make such a line economically desirable They also emphasize the *enormous* size of the apparatus units necessary If present practice were followed, 1,000,000-kilowatt transformer units would be necessary This would probably mean erecting them in the field. The problem of size and transportation becomes greater than the problem *of voltage* However, it is only a little over ten years ago that the 220-K.V line was in a similar laboratory stage as the 1,000,000-volt line discussed today

Miniature church and cottage struck by man-made lightning bolts

General view of the imitation-lightning producing apparatus employed in the High-Voltage Engineering Laboratory at Pittsfield, Mass.

A New and Novel Use for Aluminum

ONE of the most interesting news items in a long time is the statement which appeared in the daily press recently that in *Chemnitz*, Saxony, aluminum is being used as a substitute for wood in a most novel manner The statement is to the effect that aluminum sheets or plates are being used for stage scenery by the managing director of the opera house in that city It is also stated that because wood is so expensive the new material has been tried and found to be successful, but this *is not the only* advantage. Aluminum as scenery is not only lighter to handle but it is not subject to the menace of fire and it is also found that scenery can be painted on both sides of it Besides this, the paint decorations which are put on can easily be erased and no acoustic difficulties have yet appeared through the use of the new material. The aluminum is delivered to the theater in roughly rolled plates of the same form and size as are wooden sections of scenery and its thickness varies from five to eight millimeters.

This development emphasizes the role which it is not at all unlikely not only aluminum but light alloys may play in industrial life in the future It is recalled that the framework of the great American dirigible "ZR1," which is now nearing completion in New Jersey, is made almost entirely of duralumin, a *special alloy of* aluminum. In *the heat-treated* condition this alloy has a strength equal to mild steel, combined with a lightness which is a distinct asset. The Bureau of Standards has conducted some extensive tests on this material and finds that its strength efficiency, or its tensile strength divided by its weight, is 200 per cent in excess of that of mild steel. As soon as light metals and alloys are perfected in production and cheapened in cost there will undoubtedly be many other uses to which they can be put as a substitute for either wood or even steel. This use for stage scenery is but the proverbial straw that indicates the direction of to morrow's wind.

Radio Without Interference

Experiments Proving that Radio Messages May be Sent Successfully on Wave Length of Ten Meters

By D H. George

DOWN at the Cleveland Park laboratories of the Department of Commerce in the District of Columbia, latterly if you chanced to pass that way you would have seen a most unusual contraption which looked for all the world like a queer shaped tent, made of wires instead of canvas, strung in this direction, that and every other Query of one of the several scientists who were scurrying to and fro from one part of the novel equipment to the other regulating appliances and taking records, would have elicited the information that tests of wireless communication on wave lengths of ten meters were in progress

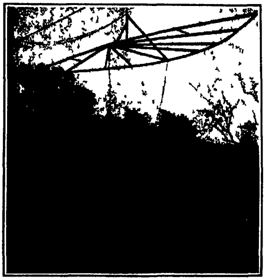
Had you been interested and inquired further about the novel apparatus—such as you probably had never seen before—the Federal investigators would have told you it was a parabolic reflector that was being used in the epoch-making experiments that have paved the way for taking the fear out of interference—the heretofore unconquerable bugaboo of radio communication

Briefly, the national search and research has developed the ironclad facts that interference between different radio transmitting stations can be reduced by the use of markedly directional antennae for transmitting and receiving, and by the use of short wave lengths not at present employed These data are of inestimable scientific importance despite that they demonstrate that directional antennae are not suitable for broadcasting market reports, music or other form of entertainment However, they can be employed successfully for the reception of such material that is circulated via wireless For point to point communications—messages sent directly from a certain transmitting station to a definite receiving station—directional antennae can be employed advantageously at both outgoing and incoming ends

It is an abrupt departure from the fundamental practices of radiography as hitherto pursued to introduce into active service short wave lengths for previously, radio communication has been carried on chiefly by the use of wave lengths of not less than 200 meters To violate precedent and to attempt to harness very short wave lengths for daily service were logically the special tasks of Uncle Sam if for no other purpose than to extend the field of radio research The use of short waves with the accompanying reduction in interference, has never been popularized despite that no less an authority than Mr Marconi himself recommends it

The ten-meter transmitter, consisting of a 50-watt vacuum tube, the elements of which are used as the condenser, and a simple coupling arrangement

Albeit the national authorities down Washington way have latterly acted on the suggestions of the inventor of wireless the result being a series of experiments in radiotelegraph and radiotelephone transmission on a wave length of ten meters using at the transmitting station a reflector composed of short vertical wires arranged as elements of a parabolic cylinder A 50-watt electron tube generating set was employed the capacity between the elements of the tube together with the grid and plate coupling coils formed the generating circuit Two short, vertical multiple-wire conductors—one above and one below the generating set—were used to radiate the waves from the generating set A special coupling coil was linked between the two vertical conductors and the generating set thus was coupled to the system The generating set with the vertical conductors was suspended in the focal axis of the parabolic cylinder Each wire of the reflector was tuned separately to ten meters by adjusting its length With all adjustments of the reflector correctly made satisfactory directional transmission was obtained The



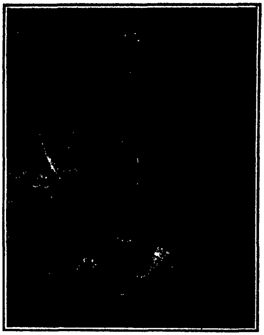
Forty wires, each 14 feet 5 inches long, spaced one foot apart in the parabolic reflector for maximum reflection on a ten-meter wave length

tests demonstrated that at least 75 per cent of the radiated power was confined to an angle of 40 degrees

Reduced to brass tacks, the data showed simply that by the use of the parabolic reflector and the short wave length radio signals and messages could be sent out in a single and definite direction without the conflicting din and confusion of atmospheric disturbances or other forms of interference The disturbances worked commonly by stray waves caused by atmospheric electricity—occasionally during the summer season these strays become so bad as to render wireless communication impossible—were practically eliminated where such short wave lengths as ten meters were used The small directional antennae used in conjunction with the wave length of ten meters markedly reduce the difficulties that emanate from itinerant strays

Furthermore, some of the more recent systems of point to point communication such as the sending of photographs by radio and the remote control of machinery and other mechanical equipment by wireless can be carried on and improved by the directive short wave transmission Between points not otherwise readily accessible radio offers an admirable method of communication where interference can be minimized In addition directive transmission makes possible extensive radiotelephone and radiotelegraph communication on a large scale with a minimum amount of power as well as with the least interference As the waves are reflected and radiated in but one direction a less powerful generating set is required to cover a certain distance than with a nondirective antenna

A 50-watt electrode tube of the coated filament type was used in the recent Federal tests because it func-



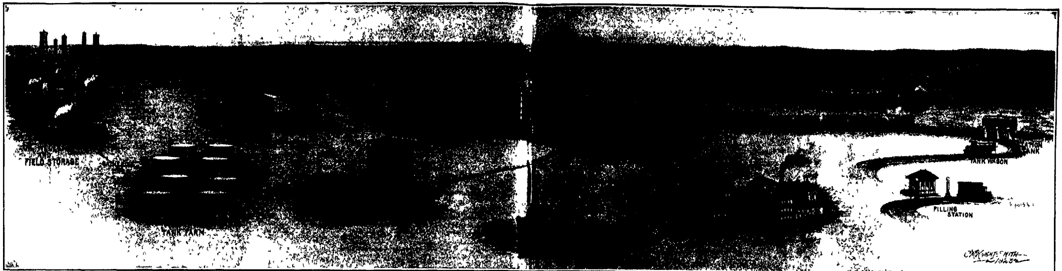
Receiving apparatus employed by Government experts in studying the directive characteristics of radiation from parabolic reflector

tioned at higher frequencies than any of the others tried out As the most effective method of obtaining directive transmission for short wave lengths was by the use of a reflector in the form of a parabolic cylinder this was the system followed The wave from this variety of reflector is quite similar to a parallel beam of light which has penetrated a small slit in an opaque screen This reflector was made by suspending 40 wires from a frame constructed in the form of a parabola Each of the wires was tuned to ten meters and spaced one foot apart The frame was hung from a rope stretched between two poles so that the reflector could rotate through 360 degrees The suspended wires were insulated from the frame and from each other The focal distance was made one-quarter of a wave length 2.5 meters or 98.4 inches The reflector was made like a parabolic cylinder because this form maintains the proper phase relations and obtains maximum reflection

For receiving signals at distances greater than 150 feet a receiving set made up of a detector and two stages of audio frequency amplification was used An external heterodyne was employed when receiving continuous wave signals The antenna used in picking up the energy at the receiving apparatus was a single wire tuned to the incoming wave frequency and coupled at its center by means of a special coil to the secondary coil of the receiving set The total length of the wire used in this antenna was 14 feet 4 inches

Reflections in all cases were imperfect where the lengths of the reflecting wires were not the same When the reflecting wires were all made the same length and the wave length of the signal source was made slightly shorter than ten meters the reflecting wires were thrown out of tune and the radiation through the rear of the reflector was equal to one half that along the true line of reflection The best possible reflection was obtained when the length of each of the 40 reflecting wires was made 14 feet 5 inches and these wires were spaced 12 inches apart All these data were obtained with the reflector having an aperture equal to one wave length The aperture was then increased to 1.5 wave lengths the parabolic frame being extended with ten tunnel wires suspended one foot apart on each extension This arrangement resulted in no leakage at the rear of the reflector Very poor reflection accompanied by considerable leakage obtained when every other wire was removed and the total was reduced from 40 to 20 This resulted because the remaining wires were detuned by the removal of their neighbors

To determine the effect of leakage through a hole in the parabola ten consecutive reflecting wires were removed with the consequence that heavy leakage occurred These tests showed that for efficient directive transmission the source of the waves to be reflected must be placed exactly at the focus the reflecting wires must be tuned to resonance with the source while the width of the reflected wave front is dependent on the size of the aperture employed Strong signals were received at a distance of two miles using a single-turn coil antenna six inches in diameter



In 1922 the United States produced over 23 billion gallons of crude oil, 62 per cent of the world's supply. The above diagram shows how it is piped to the refineries and distributed to gas plants, shipping, factories, railroads and the automobile filling stations

The Story of Oil

How 23 Billion Gallons of Crude Oil Annually are Piped, Refined and Distributed to the Consumer

EARLY in the last century petroleum was a nuisance. The oil seeped into salt wells and spoiled what was an altogether more valuable commodity. The crude oil skimmed from springs and pools, was used in a small way as a medicine, "good for man or beast," and a few persons burned it in lamps. It gave a good light but its odor was offensive and it was by no means as popular an illuminant as whale oil.

Later it was demonstrated that the oil had lubricating properties far superior to the animal oils and greases then in general use. It was also discovered that by filtering the crude petroleum through charcoal, or refining it in crude stills, much of the offensive odor could be removed and the illuminating power enhanced.

Thus, by slow steps the use of petroleum increased until the old method of recovering it from the surface of pools and springs failed to yield sufficient oil to supply the demand. And, so in August 1859, Colonel Edwin L. Drake drilled in the first commercial oil well in this country near Titusville, Pa. This little well—it was only 69 feet deep and its total yield that first year was less than 2000 barrels—was the real beginning in the United States of what is today one of the world's greatest industries, without which modern social and industrial life would be impossible.

Following Drake's effort a wave of development swept over the Pennsylvania oil fields, spreading to Ohio, West Virginia and Kentucky, and, later, to the great mid-continent and California fields, which today are the most important oil producing territories in the world.

It is safe to say, however, that none of the pioneer oil men—and they were a fairly far-visioned lot—foresaw the lengths to which the industry they were creating would go. As a matter of fact, oil men of the present generation have seen created a new industry which bears practically no resemblance to that in which they received their early training. The basic commodity—crude petroleum—is the same, but that is about all.

The change has occurred since 1906, when the main purpose of the petroleum industry was to supply the world with an illuminant—kerosene—of which about 33,000,000 barrels were produced in that year.

Since 1906 the internal combustion engine has come into universal use. Kerosene is no longer the principal commercial product of crude petroleum. Its place has been taken by gasoline and today the industry's reason for being is to supply the world with constantly increasing quantities of motor fuel. It is interesting to note that last year the production of kerosene was about 55,000,000 barrels, or an increase in sixteen years of slightly more than 63 per cent, while the production of gasoline was about 143,000,000 barrels, compared with only 8,000,000 in 1906, or an increase of 1750 per cent.

As it exists today the petroleum industry is composed of four distinct but closely related branches—production, transportation, refining and marketing. Each of these has its own particular problem and each must be considered separately as well as in its relation to the others if any comprehensive picture of the industry is to be obtained.

Production naturally comes first and the statistical position of this branch is easily stated. The United States produces about 62 per cent of the world's supply of crude petroleum. There are at present more than 280,000 producing wells in this country and the 1922 output was 550,000,000 barrels of 42 gallons each.

There is no assurance, however, that the present rate can be maintained. Oil production is a most uncertain business and it has been well said that nobody can tell today where oil will be found tomorrow, nor, having been found, how long the supply will last.

Therefore, although opinions differ on the probable extent of the future supply of oil in this country and in the world, there can be no doubt that the continuity of the supply depends entirely upon the discovery and development of new and important pools here and elsewhere. To this end, prospecting for oil is continuous and in this work the so-called "wildcatter" is a most important factor.

Locating oil is an uncertain and expensive proposition. Materials for drilling have to be transported long distances over terrible roads or no roads at all. Too often the wildcatter may have put every cent he owned or could borrow into the venture, only to have his efforts end in failure. The percentage against the producers may be judged from the fact that out of 23,831 wells completed east of the Rockies last year only 16,701 were producers.

Oil wells vary in depth according to the territory in which they are drilled, but the average depth of all wells drilled in 1922 is estimated at 2827 feet.

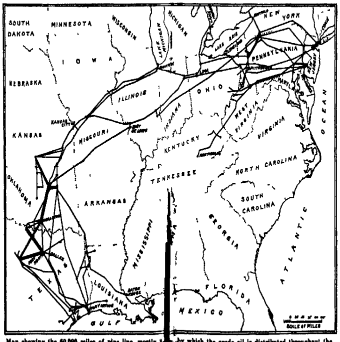
Drilling equipment consists of the familiar derrick, various drilling tools, cables and an engine. Derricks range from 90 feet upward in height and are usually made of wood, although steel construction is finding favor. The derrick is erected immediately over the spot to be drilled and in the ordinary rig, the cable is passed over the crown pulley at the top, one end is attached to the drilling tool and the other wound on the shaft of a bull wheel. The end of the walking beam, operated by a band wheel, is clamped to the cable above the drilling tool, the engine is connected and the rig is ready to start. Steam power is usually employed, although electricity is sometimes used.

This is the percussion method of drilling and is the one most widely used, especially in hard formations. The rotary drill is favored for soft formations and sometimes a combination of rotary and cable drilling is resorted to.

Actual drilling may be completed in a short time or the petroliferous sand may not be reached for months. So many delays are possible that no accurate estimate can be made in advance. For instance it frequently happens that the drilling tools are lost in the hole, necessitating the tedious job of fishing for them with various tools made for the purpose. Then the casing, or steel pipe used to line the hole to keep out water and prevent caving, may become "frozen" or stuck. When this occurs it is sometimes necessary to use a nitroglycerin "squib" to break the grip of the surrounding soil and release the casing. All of these things make for serious delays and add to the expense.

When the oil bearing sand is reached it sometimes happens that there is pressure of gas at the bottom of the well sufficient to force the oil in a stream far above the top of the derrick. Such wells are known as "gushers" and are brought under control as quickly as possible in order to prevent waste. More frequently, however, the completed well is "put on the pump" and the oil brought to the surface by this means. The average yield of all wells in the United States is in the neighborhood of five barrels a day.

Occasionally it happens that a well does not yield freely or shows signs of exhaustion, and "shooting" may be advisable to loosen the oil sand and stimulate the flow. This is done by lowering a torpedo loaded with nitroglycerin to the proper depth and exploding it. The quantity of nitroglycerin used varies with conditions, but up to 100 quarts has been fired in a single charge. Shooting is not always successful and wells have been ruined by too great disturbance of the oil bearing sand.



Map showing the 60,000 miles of pipe line, mostly 8-inch, by which the crude oil is distributed throughout the United States

As the crude oil comes from the well it is run into field storage tanks. These are comparatively small steel or wooden containers and are not intended to retain the oil for any length of time. It frequently happens, especially where wells come in with a heavy initial flow, that earthen storage is used, the earth being banked up to hold the oil in a large pool. This method is wasteful owing to evaporation, losses as high as 40 per cent having occurred.

It is at this point that the production and transportation branches of the industry overlap. The oil is taken from field storage through a system of so-called gathering lines, which are of 2- to 6-inch steel pipe, through which the oil is pumped to the "tank farm." This is a collection of huge steel tanks where the oil is gathered before being distributed by trunk pipeline to the refining centers.

There are more than 60,000 miles of trunk pipeline, usually of 8-inch steel pipe, operating from the producing fields across country to terminals located on the Atlantic, Gulf and Pacific coasts, where the oil is refined or shipped as crude in tank steamers or cars. The trunk pipelines are common carriers and are under the control of the Interstate Commerce Commission. At intervals on the lines are pumping stations to force the oil along. In the Eastern and mid-Western regions, these stations are about 35 miles apart, but in California, where the oil is much heavier, pumping stations are located every 12 miles or so and even then it is sometimes necessary to heat the oil.

Employed in the transportation of oil, both crude and refined, are more than a thousand tank steamers, or tankers as they are called. Of these nearly 400 are under American registry. The average capacity of the American tankers is 67,000 barrels.

Tankers are used for transporting crude oil, fuel oil, lubricating oil and gasoline. Within recent months they have been used to bring large quantities of California crude through the Panama Canal to refineries on the Atlantic Coast. This is somewhat of an innovation and was made practical on a large scale by the state of the market incident to the recent enormous production of California crude. As a rule the crude oil refined on the Atlantic and Gulf coasts has come from the mid-Continent and Gulf fields and those east of the Alleghenies.

The refining of crude requires complicated apparatus, but the operation may be briefly described as progressive distillation at successively higher temperatures. Gasoline, being the most volatile product, is naturally driven off at the initial heating. The temperature is then increased and kerosene results. Thereafter come in order gas and fuel oils, lubricating oil, paraffine wax, coke and asphalt, depending upon whether the crude has a paraffine or an asphalt base, and lastly a variety of minor products the character of which also depends upon the crude.

It probably will be a revelation to those of the motoring fraternity who seem possessed of the idea that all that is necessary to obtain a barrel of gasoline is to run a barrel of crude through a refinery, to learn that some crude has not sufficient gasoline to warrant refining it at all. The average yield of refined products from a 42-gallon barrel of mid-Continent crude is as follows: Gasoline, 25.6 per cent; kerosene, 9.7 per cent; gas and fuel oils, 47.9 per cent; lubricating oil, 4.3 per cent; wax, coke and asphalt, 2.4 per cent; miscellaneous products, 6 per cent; loss in refining, 4.1 per cent.

A method of increasing the yield of gasoline by what is known as the "cracking" process has been perfected and is in use in 127 of the larger refineries. This involves the redistilling, under pressure, of gas and fuel oils so that the molecules are disintegrated or "cracked." By this process the average gasoline yield of mid-Continent crude has been increased from 8 to 15 per cent. The cracking system is costly to install, however, and is practicable only for refineries having a large and constant run.

At this point the refining, transportation and marketing branches of the industry overlap. Obviously the refined products have to be taken away from the refinery and distributed literally to the ends of the earth. Gasoline, kerosene and lubricants are shipped to market or pier in barrels, drums, wood-encased cans—the case oil of commerce—or tank cars. Domestic bulk shipments are made exclusively in tank cars. These cars are familiar sights to the traveler. There are about 143,000 of them in the petroleum service in the United States, with an average capacity of 9000 gallons. All but 11,000 are privately owned, that is by refining and oil transportation companies.

The usual system of domestic distribution is as follows, taking gasoline as being the product with which the public is most familiar. Shipment is made by tank car from the refinery; at destination the gasoline is pumped from the car into the distributor's tanks, from there it is taken by tank wagon or truck to the public filling station or direct to the consumer's private tank, whence it passes into consumption. The consumption of gasoline in the United States alone last year was nearly 5,350,000,000 gallons, in addition to 600,000,000 gallons exported.

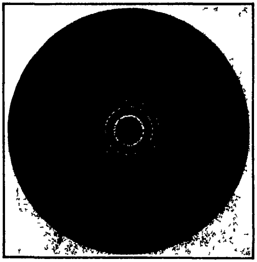
Actually, gasoline is one of the greatest problems with which the more than 400 American refineries have to deal. This is on account of the seasonal demand, which is subject to wide variations. The lowest point is reached, of course, during the winter months and the demand gradually increases as the weather grows warmer, until the peak is reached in midsummer, when consumption will be more than 100 per cent above the low point. In order to meet this fluctuating demand, it is necessary for the refineries to operate on practically a uniform basis throughout the year, storing the product in slack season.

It is estimated that each registered automobile, including trucks, taxicabs, buses and pleasure vehicles, consumes about 125 gallons of gasoline a year. This estimate makes no allowance for airplanes, motor boats, tractors or other internal combustion engines. Of course, the gross consumption increases from year to year. The 1922 consumption of 107,000,000 barrels was 28 per cent greater than that of 1920 and 18 per cent more than that of 1921. The consumption during April of this year was at the rate of 140,000,000 barrels a year, or 7,000,000,000 gallons, plus exports of 11,000,000 barrels, or 700,000,000 gallons, and April is not ordinarily a month of peak consumption.

Measuring with Light Waves

How the Various Wave-Lengths are Made to Serve as Scales

By W. F. Meggers, Ph. D
Physicist United States Bureau of Standards



Interference fringes produced by passing monochromatic light through an interferometer

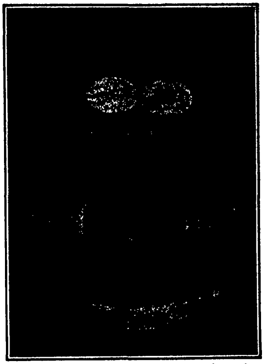
IN THESE times when the ether is throbbing with radio waves everyone has acquired increased interest in and understanding of electromagnetic phenomena. It has required nearly a century to show that visible light, heat energy or infra-red light, ultra-violet light, electrical waves used in "wireless," and finally X rays and the gamma waves arising from radio-active materials, are all similar electromagnetic wave motions in the ether, and are distinguished only by a difference in wave-length. All these wave motions represent transfers of energy and they are propagated in free space with the same velocity, about 300,000 kilometers or 186,000 miles per second. These waves can be imagined to originate in oscillating or vibrating mechanisms in which the frequency of oscillation is a fundamental constant of the particular vibrating system. It is evident that when this frequency (number of vibrations per second) is multiplied by the wave-length (distance between crests of adjacent waves) we obtain the velocity or linear distance traversed by a wave in unit time.

The entire range of wave-lengths with which science has become familiar extends from thousands of meters (1 meter = 39.37 inches) for waves used in radio communication to about one hundred billionth of a meter (0.000000004 inch) for the shortest X waves. In terms of frequencies this range extends from a few thousand vibrations per second for wireless waves to 30 quintillions (3 followed by 19 ciphers) for the shortest among X waves. Of this enormous range of wave-lengths the waves of ordinary light comprise a relatively small portion (from 4 to 8 ten millionths of a meter or 16 to 32 hundred thousandths of an inch) but this is the only portion for which nature has specifically endowed us with organs to sense.

White light is a mixture of many different colors each of which represents light waves of definite length. When white light is dispersed and resolved into its component colors, as happens in the rainbow or in certain optical devices (prism or diffraction grating spectroscopes), a continuous spectrum—a natural scale of colors—is formed in which different waves (colors) are arranged in order of their length, the violet representing the shortest, the red the longest ones visible. All incandescent solid substances (the sun, the electric lamp filament, the luminous gas flame) emit such a continuous spectrum. Elementary substances, however, when made luminous in flames, electrical arcs or sparks, in general do not emit continuous spectra, but when viewed with a spectroscope show bright colored lines on a dark background, each monochromatic line representing a definite frequency or wave-length. Thus, when an electric current passes in an arc between two pieces of pure iron, some of the iron is vaporized and emits a spectrum consisting of more than 4000 lines, and waves of other lengths than these are absent from the train of energy given off by this element. The number of lines and their spectral distribution is different for different elements, but each chemical element when properly excited to emit a spectrum shows bright colored lines whose absolute wave-lengths and relative intensities are characteristic of that element alone. This fact is the basis of spectrochemical analysis; the presence of a particular chemical element is positively established if one or more of its spectral lines are identified.

Now it might be assumed that each spectral line represents one and only one wave-length but this is not the case, the lines actually have finite "width" and represent an extremely short stretch of spectrum. The average width of a line from the iron arc, for example, is 60 trillionths of a meter, while that of the red line from cadmium is about one-tenth as great. A very narrow line is almost ideally monochromatic and permits a more accurate measurement of wave-length than a broad line. This finite width of spectral lines is principally due to the thermal agitation of the molecules or atoms in which the radiation has its origin, which, by a curious coincidence, was chosen by Professor Russell as the subject of his monthly talk for this issue. (See page 264.)

In 1864 Fizeau, a famous French physicist, stated that "a ray of light with its series of undulations of extreme fineness but perfectly regular, may be considered as a natural micrometer of the greatest perfection, perfectly suited to determine lengths." Nearly 30 years later Professor Michelson, the American physicist, went to the International Bureau of Weights and Measures near Paris and determined what number of wave-lengths of red, green and blue light emitted by luminous cadmium vapor equaled the standard meter, which had been established 100 years earlier with the intention that it should represent one 40-millionth of the earth's circumference. This experiment was repeated in a slightly different way in 1907 by French scientists and the results which they obtained agreed with those obtained by Michelson to one part in sixteen millions.



The gages are placed on a true plane, and a second true plane of glass is placed on top. Monochromatic light is passed through the upper sheet of glass, and interference fringes arise from its reflection from the lower surface of the glass and the tops of the metal gages. These fringes give information not only on the relative lengths of the gages but also indicate errors in flatness and parallelism of the end surfaces. More details of the process may be found in the SCIENTIFIC AMERICAN for July 19, 1919

Comparison of gages by means of light waves

The wave-lengths of several hundred other spectral lines have been compared with that of the cadmium red line and these are called secondary standards. They comprise selected sharp lines from various light sources such as the iron arc or spectrum tubes containing rare gases, and are fairly well distributed throughout the spectrum from ultra-violet to red, so that they may serve as reference standards for the measurement of other wave-lengths and for length measurements in general. The probable error in these standards does not exceed one part in five million and in many cases it is even less. Such results are actually obtained by the use of suitable optical apparatus called the "interferometer," in which the physical principle involved is the same as that which explains the beautiful colors observed in thin films of oil on water, namely, the interference between waves reflected from two parallel or nearly parallel surfaces. If it were possible to measure with the same accuracy a distance of ten miles, it would mean that this length could be determined correctly to within one-eighth of an inch.

In recent years the Bureau of Standards has carried on extensive investigations with the interferometer to perfect a system of suitable standard wave-lengths and to develop the application of these to precise measurements of length. This laboratory has compared the wave-lengths of more than 500 iron lines with the primary standard, 29 lines in the spectrum of helium, 55 in neon, 50 in argon, 18 in krypton, 12 in xenon, and 12 in cadmium.

All light waves have their true fundamental length only in a vacuum. In ordinary air like that in which we live and make measurements, the visible light waves are slightly decreased in length (by about one part in 3500). The ratio of a wave-length in air to its fundamental value in vacuum is equal to the so-called index of refraction of the air and this varies throughout the spectrum and according to the density of the air as determined by its pressure and

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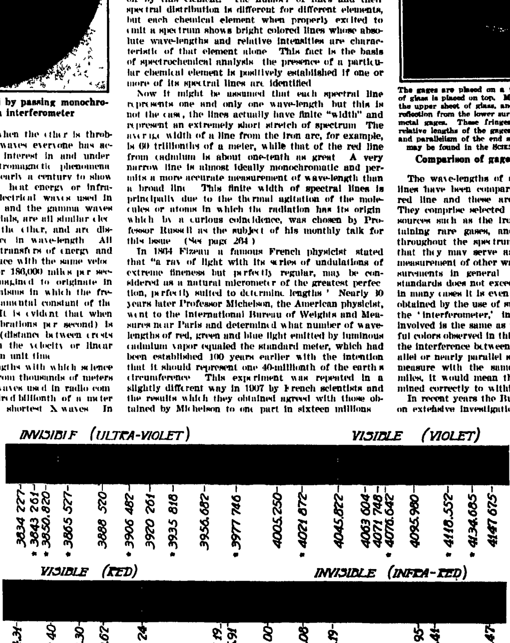


Wave-lengths corresponding to some of the bright spectral lines are marked in international units of one 10-billionth meter, those with asterisks being international secondary standards. It will be noted that the photographic plate is sensitive in both directions far beyond the limits of the human eye

Visible and invisible portions of the iron arc spectrum

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

The device that enables the driver to protect himself from glare

Bright Lights—But No Glare

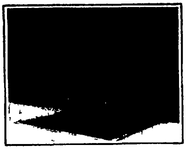
ALMOST everyone who has sought to solve the glaring automobile head light problem has gone at it from the standpoint of dimming or diffusing the rays of the headlamps by means of special lenses, shades or other similar apparatus, failing to recognize that it is practically impossible to subdue the rays of the oncoming lights to the extent that they have no glare without sacrificing some of the road illumination for which they are put on the car. A solution of the problem from the logical standpoint would be to make the driver immune to the bright rays of the oncoming car, thus enabling the other fellow to have the needed road illumination without in any way affecting the driving vision of the man whose car is properly equipped.

A well-conceived attempt to do this consists of a small black-enameled plate of sheet metal attached to a ratchet device to enable its being adjusted to any desired angle. It is arranged to fit the top of the windshield by a universal holder (a special fitting is provided for enclosed cars), and the right edge is set on a line with the center of the steering wheel. In the daytime the metal shield is swung up out of the way being held firmly in any position by the ratchet mechanism. In use, the shield is swung down at such an angle that the driver can look out under its lower edge and see several hundred feet ahead to enable ample driving vision while at the same time the dazzling rays of the other fellow's lights are excluded by the metal plate. A few minutes experimenting will show the driver just which is the right setting for his car and his height, and once properly adjusted it need never been disturbed.

The latest convenience for the man who works at the edge of the roof

What Is Glare?

THE sub-committee of lighting engineers that has been examining the nature of glare recognizes, in its report, several distinct varieties. "Veiling glare" is produced by light somewhat uniformly superimposed on the retinal image, thus reducing contrasts and visibility, and corresponds to the fogging of a photographic plate. "Dazzle glare" is produced by adventitious light so refracted and scattered as not to form part of the retinal image. "Scotomic glare" is produced by light of intensity such as to fatigue the retinal sensitivity below the concurrent limit for usual images, and corresponds to overexposure in photography. The influence of these three forms of glare is analyzed and some experiments made to determine the magnitude of the effects described. A target on which the black letters in various positions were distributed, was illuminated by a concealed source. For the purpose of producing glare incandescent lamps were mounted behind a small central aperture in the target and for producing extreme dazzle glare an automobile headlight was exposed. Veiling glare was produced by superimposing a lantern slide so as to cover the field of view and tilted so that an image of an illuminated surface was seen by reflection; the target was thus seen through a luminous haze. Quantitative data, illustrating the reduction of visual acuity are presented. It is concluded that dazzle glare is of the most serious consequence, and some suggestions for further experiments made.



When the elevator is idle there is no obstruction to the sidewalk

One-Man Railway for Roof Workers

THE Seattle *Daily Times* has installed on the top of its six story newspaper building a small "one man" railway for the convenience of workers on the roof. A little car located on the roof carries a 200-pound counterbalance, which circumnavigates the roof. The photo shows how a man, standing in the platform suspended from the car, can reach all cornice lights on the building.

Double-Lever Steering for the Flivver

WHAT the driver of the small car with its direct lever steering connection instead of the more effective worm gear, needs more than anything else is additional steering leverage to control his car in an emergency, to prevent the wheels being jerked out of his hands or the locking of the front wheels beneath the car. The principle of compound leverage is utilized to give him this increased power in the steering device illustrated herewith. Instead of one ball joint and one lever as when it comes from the factory, the car thus equipped steers through two levers and two ball joints.

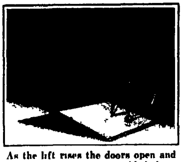
In installation the single lever comes off the bottom of the steering post and is replaced by the compound lever *A*, which actuates the steering arm *B* through the fulcrum provided by the ball and socket joint *C*. There are no gears and no springs.

Compound-lever steering for the car that lacks a worm

An Accident-Proof Sidewalk Elevator

AMONG the features of modern city construction that offer great danger to life and limb when not properly safeguarded is the elevator shaft rising at the edge of the sidewalk. Practically every large building disposes of its ashes by thus bringing them to the surface, and more than one pedestrian has been killed or injured by suddenly having a section of the sidewalk disappear beneath his feet or fly up into his face to make a place for the elevator to rise out of.

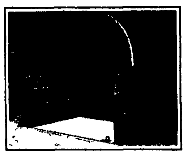
The provision of gates and warning signs is not sufficient as is amply proved by the number of persons killed at well protected grade crossings. What is needed is something that absolutely prevents the elevator from rising when there is any reason why it should not rise. We illustrate the installation designed by a New York concern which does this.



As the lift rises the doors open and the gates swing out, provided there is no obstruction

When the elevator is inactive the gates fold back against the wall as shown in the first view. When the control is thrown over to start the elevator upward a stentorian ringing is heard for some little time before the flat doors in the sidewalk break at their central point of junction. With this breaking, the gates swing out. The last possibility that somebody might be hurt is removed by the fact that any weight on the rising doors, or even so light an obstruction as a hand placed upon the swinging gates will hold the elevator motionless until it is removed. The whole apparatus is so interlocked electrically that it seems absolutely foolproof.

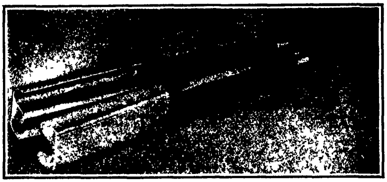
Residents or visitors in New York who are interested in seeing this elevator in operation will find a typical installation at the Park National Bank on Fulton Street, just off Broadway.



When the elevator reaches its limit of travel the above appearance is seen

Short-Wave Oscillator at Low Pressures

IN experiments with triode tubes giving wave-lengths of the order of a meter Barkhausen and Kurz found a type of oscillation apparently due to the motion of electrons in the tube itself independent of the external capacity and inductance. Whiddington observed lower frequencies and attributed the effects to the motions of ions instead of electrons. Gill and Morrell have given an explanation involving the natural oscillation of the electrical system connected to the tube. Previous investigators used commercial tubes incapable of modification. E. L. Nettleton now reports in Proceedings of the National Academy of Sciences, December 1922, experiments with a tube left permanently connected to the vacuum pump and made with a ground glass joint to make the internal parts accessible for modification. Electron currents as high as 300 milliamps and voltages as high as 700 were used. The arrangement is illustrated. A Lecher circuit was used and to measure the wave length a thermo galvanometer was employed. Oscillations of the Barkhausen type at wave lengths of 50-200



Another article for the home beauty-factory—a marcel waver

ion were obtained, and the occurrence of a negative plate current demonstrated. Both oscillations and negative plate current ceased at very low pressures. The pressure of the residual gas was measured by the resultant ionization.

A Versatile Woodworking Machine

A MACHINE operated by electricity which will do almost any sort of work done in the woodworking industries is a recent development of a Cincinnati manufacturer. The machine is mounted on four wheels with a three- of construction allows a very quick change to be made from one tool to another; as a matter of fact it is claimed that the change is made as rapidly as if one had to look for the desired tool in a chest.

After the tool is made up it is flexible and is suspended over the work and in use is pulled down to the work and a perfect balance taking place makes it possible to relieve the work of any unnecessary weight.

It is claimed that a compound miter such as the top of a hip rafter is made as easily as a square cut and all opera-

abrasives can be left in the cylinder wall, to continue cutting after the engine is assembled and in operation. The hone fits itself without adjustment to any cylinder from 2 13/16 to 5 inches in diameter. For larger cylinders, extension blocks may be set into each wing of the hone, and it acts automatically as before. The hone is designed to be driven at speeds of 800-1100 revolutions per minute, by a portable electric drill, standard drill press, or other rotary machine.

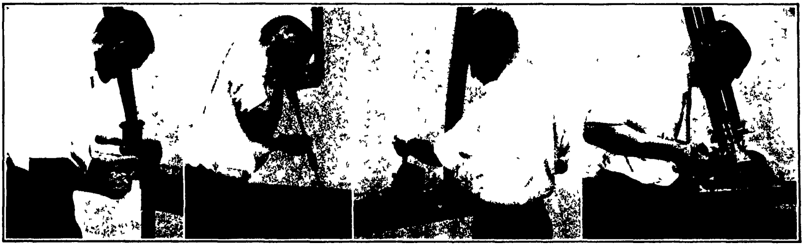
Beauty Via the Marcel Way

AS the creation of beauty is a part of the pursuit of happiness the lady with straight locks considers the acquisition of curls one of the legitimate ambitions of life! As a means to this end there is manufactured now an electric marcel waver for individual home use at a price practically the same as the better makes of electric curling irons. Hitherto the lass with the bobbed tresses and the matron with white hair have had to depend upon visits to a beauty parlor to obtain the coveted marcel wave. As the waver has two heating elements, between which the strands of hair are laid, the heat is evenly applied, and our picture shows how three waves are made at one operation.

Longitudinal and lateral springs on the same car

A Novel Spring Assembly

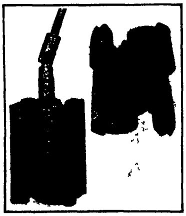
DESPITE the unanimity of automobile manufacturers—withholding for the moment the admission that the tin lizzie is an automobile—for the longitudinal spring, the lateral type that characterizes the genus flivver has its advantages. Some such thought as this must have been in the mind of the California inventor who designed the combination we illustrate herewith in which an attempt has been very obviously made to hang both types of spring upon a single car. Across the projecting ends of the conventional longitudinal springs a heavy bar member has been



Grinding | Angular boring | Straight mortising | Mitering or beveling

The all-around woodworking machine, shown in a few of the many uses to which it may be put

point suspension so that it can run on a track on a carpenter's bench. Its position on the bench is such that the flexible drop hangs over the work side of the bench. A 1½ horsepower motor develops sufficient power to work two-inch stock and under. The tools are mounted on mandrels individually which are inserted into a hollow spindle to which the driven pulley is secured. This type



Sectional and longitudinal views of the cylinder hone that automatically adjusts itself to the size and center of cylinder

tions are done while the timber lies on the bench. A stair horse can be cut, it is claimed, as quickly as a man can lay it out, with a square and pencil, and the steps are cut square while the risers are cut either square or mitered. Where mortise locks are to be made the doors are stacked up near a work bench and twenty mortises, countersunk for the face of the lock may be done in an hour.

The cutter supplied with the machine will do all the simple moldings, beading, tonguing, grooving and splining. To take the place of an ordinary brace and bit a boring mandrel is supplied. For screw driving work a bit with a countersink right on it is used and this makes the hole and the countersink at the same time.

An Automatic Cylinder Hone

DEPENDING upon centrifugal force to expand it to proper size and to force the individual stones into contact with the cylinder walls, the new hone recently put out for automobile use by a Chicago firm is self adjusting, self centering and self aligning. In this way is insured equal pressure on all stones with the elimination of springs and the prevention of unequal pressure upon the stones. The stones polish the metal surface without the use of any liquids or lapping compounds and without filling. This is a great advantage in that no

The Folding Toothbrush

DENTISTS agree today that one habit worth forming is to carry a toothbrush if you are away from home for the entire day. This brush has been specially designed for this purpose. The brush separates from the container and goes into it when not in use. The case is metal, ventilated for drying, and is of such a length that it will fit many places—among them the vest pocket.

placed, and below this, attached at both ends and in the middle hangs a very flat spring, cross-ways of the car. The front axle is supported, not on one of these and through that one upon the other, but actually in part on both. The result is claimed to be extraordinary success in actually taking up, in the springs, without transmission to the body and without the use of shock absorbers, all the jolts of heavy going.

The toothbrush that folds up and goes in the pocket

Handy carrier that reduces milk-bottle casualties

No More Spilled Milk

IT is the fate of children as well as grownups some time to cry over "spilled milk." The family milk bottle when held with other kitchen supplies will slip from the hands or arms of the carrier. A bottle carrier shown here is said to prevent such catastrophes and hold the bottle safely. It provides a wooden handle, when held as shown, which locks the two wire supports securely under the rim of the bottle top.

Daylight Reflections in Show-Windows

POLISHED plate glass forms an excellent mirror, and reflections of brightly illuminated objects in streets are apt to be formed at the glass of show windows, interfering with the effectiveness of the display. Attempts have been made to overcome this by using curved glass, but the lower edge of the glass is then located 1½ to 2 feet behind the front line of the window and such special glass has other drawbacks. Inconvenient reflections may, however, be eliminated by the use of sufficiently high artificial illumination within the window. Objects in bright sunlight may be illuminated to 5000 foot-candles and the images of them on the plate glass may appear about one-tenth as bright as the objects themselves. Hence an artificial illumination of 1000-2000 foot-candles is needed to render such images imperceptible.

In transactions of the American Illuminating Engineers Society for December 1922, Harrison and Spaulding describe the use of six floodlights, yielding 25,000 aggregate candlepower to overcome such effects. The lighting units were mounted in recesses in the ceiling, the light being transmitted through panes of diffusing glass, and the angle at which the reflectors were tilted could be adjusted within wide limits so as to get any desired effect. The frames containing the diffusing glass were hinged so as to afford access for cleaning. Besides overcoming the difficulty of troublesome reflections, this special method of lighting added to the attractiveness of the window. Tests showed that when the artificial lighting was on the number of people who stopped to look at the display was twice as great as when the window was unilluminated.

Combination laundry outfit that includes a hot-water boiler

Light-Weight Radio Set

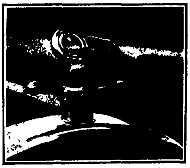
THIS little radio set held in the palm of the hand can also be carried in the pocket. *Its manufacturers claim* for it that it is sturdy and dependable and not in the least a toy. Its tuning in facilities enable the user to cut out all interference.

All that is necessary for enjoying radio concerts while hiking, motoring or camping is a headset and a few feet of wire to hook up to a wire fence and ground.

Screws On but Never Off

THE mechanical arrangement for locking this radiator cap in place is interesting. A bushing inside the cap contains a thread for screwing on to the radiator plug. This bushing is arranged *with a ratchet so that it will* screw on but never off. A thief cannot remove it.

In addition to this feature it eliminates the trouble and time usually necessary to remove the regular radiator cap



Theft proof radiator cap that springs back to admit water

for filling the radiator with water. To fill the cap and motometer turn back with a spring arrangement. Removing the hand springs it forward over the opening.

The Cottage Laundry

FOR the summer shack or small cottage that is not provided with laundry tubs, this combination of tub, wash board and boiler in one will be found convenient.

Many small articles that must be laundered frequently can be cleansed on this tub board. It is used as shown.

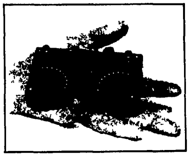
Static

SIX papers in *Radioélectricité*, issues for July, 1922, to February, 1923, deal very thoroughly with the various possible sources of atmospherics or "parasites" encountered in everyday practice of wireless telegraphy, and discuss in very great detail the numerous methods which have been employed by the authors and others to eliminate the trouble. In the first paper the authors classify atmospherics as follows:

(*a*) Atmospherics due to storms (accompanied by lightning flashes), (*b*) local atmospherics—due to voltage fluctuations in the atmospheric layers near the receiving aerial, (*c*) cosmic atmospherics—originating outside the boundaries of our planet, possibly having solar sources, (*d*) miscellaneous—presence of clouds, temperature of the air, atmospheric pressure, etc.

Consideration is given to diurnal and seasonal variations of intensity of the parasitic signals. The form of the wave, optimum wave-length, etc. are also discussed. With regard to the elimination of 'atmospherics,' numerous circuits are described in detail. The more important of these are classified by the authors as follows:

(*a*) Continuations of high frequency circuits—Fessenden's circuits, (*b*) methods employing detectors in opposition (Round's double crystal or double-valve method)—in which one detector is sensitive, the other less sensitive and in opposition, (*c*) saturated systems (Marconi Wright system)—limiting the



This month's radio midget

maximum amplitude of the "strays" by adjustment of valve system near saturation current, (*d*) miscellaneous—Marconi's method in which a nodal point (for a certain wave-length of reception) in the antenna circuit is connected to earth. The "strays" of different wave-length is conducted direct to earth while the tuned signals are transmitted through the receiving circuits in the usual manner. Systems invented by de Groot, Pupin (negative resistance method), and others are described in considerable detail.

For the comparison of efficiency of various systems in eliminating parasites the authors have devised a means of measuring the relative intensities of the strays and the normal signals. A method *depending on a new principle is* developed and various modifications of the method are described in detail. It depends in principle on the observation that 'atmospherics" are usually propagated in a direction normal to the surface of the earth.

Centralization of German Long-Distance Radio

IN order to facilitate overseas traffic a receiving station has been installed at Geltow about 30 kilometers in a southerly direction from Nauen. A similar arrangement has been adopted at Eilwese, the receiving station for which is now at Hagen. It is intended to use the new stations for communicating with a distant station from Berlin using Nauen for transmission and Geltow for reception, land lines connecting each of the latter with Berlin and for communicating with New York, using the station at Rocky Point for transmission and that at Riverhead for reception.

No Dust Escapes

VACUUM cleaners have come into extensive use in the home, but there is still some dust for the dustpan.

None escapes this improved pan because of the wire arrangement shown at the back of the dust catcher. When the foot is applied to the wire the front

The dustless vacuum cleaner

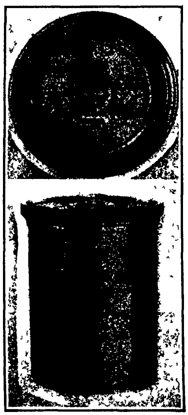
of the pan hugs the floor, permitting no dust or dirt to escape underneath.

The short handled dustpan should be no more. This long handled one takes the stoop out of stooping, and when raised carries the pan in an upright position shutting the dust inside where escape is impossible.

A Better Barometer

ANEROID barometers in use since the seventeenth century have all been constructed on the same lines. They are rather unreliable and owing to friction and elastic retardation they even *record an increase in pressure* when a decrease has occurred, or vice versa. This is claimed to be eliminated in a new type of aneroid invented by G. Paulin of Stockholm, which is so sensitive that it will register the difference in air pressure and hence in height when moved from the table top to the top of a book lying on the table.

As altitude meter the new instrument is expected to be of fundamental *importance to the aviator. In rapid de*scent instruments of the old type were often 25 or 30 meters in error while the Paulin outfit can hardly be more than one meter off. The instrument is not confined to aviation however; it can be applied to a large number of other purposes, such as ground surveying, mine and artillery determinations etc. A spe-



Two views of the newest and most accurate barometer

Lubricating an automobile chassis by means of the high pressure system

cial light type is offered for such uses as these. Also in naval and mercantile marine uses the Paulin aneroid should give a far more accurate weather forecast than its predecessors.

High-Pressure Lubrication for the Automobile

FOR a true appreciation of automobile chassis lubrication it is necessary for one to handle the old fashioned messy grease cups. These cups are filled with grease and screwed down so as to force grease down to the bearing surfaces. As often as not the cups, not being sufficiently filled, failed utterly to perform their function with the result that rapid wear soon asserts itself in high repair bills.

It has remained for an ingenious American to develop a simple system of high pressure lubrication for the automobile. In this system which is now standard on our leading makes of automobiles, use is made of patented ball check valve fittings in place of the messy grease cups and by means of a hand compressor the lubricant is forced into the bearings under a pressure of 500 pounds to the square inch. This method has a double advantage for while it is forcing the fresh lubricant in, it is forcing the old grease out. Thus it ensures clean bearings at all times if used frequently enough. The makers advise complete lubrication of the chassis every 500 miles.

The high pressure lubrication system can be had with either a flexible hose which makes it easy to reach the inaccessible lubrication points or with a new spiral valve compressor in which the compression is built up before applying to the fitting and is automatically released when the connection is made. With the spiral valve compressor either oil or solidified lubricant can be used, under a pressure of 2000 pounds per square inch.

One of the greatest difficulties to overcome in lubricating automobile chassis is clogged bearings. Sometimes especially in tight fittings the grease hardens and cakes and when fresh lubricant is applied even under forced pressure the resistance is so great that the old grease cannot be dispelled. If this condition is not remedied the dirt and grit in the bearing goes on chipping and grinding away until the bearing is ruined. To solve this problem a pump has been invented which is capable of developing a pressure up to 5000 pounds per square inch which is sufficient force to clean out any bearing no matter how badly clogged. It is a simple piece of mechanism and the price is relatively small bringing it within the reach of anyone using the regular equipment.

Another feature of this lubrication system is an all metal lubricating spring cover made up of overlapping steel plates which give it the necessary pliancy and keep out dust and water while retaining the lubricant. Under the pressure of the lubricating compressor the lubricant is forced in between the leaves of the spring provided with the cover.

The many advantages of this high-pressure lubricating system have made it a standard feature of 8 000 000 motor cars now in use. Besides it is finding many industrial applications, where positive lubrication at frequent intervals with a minimum of labor is a prerequisite.

Gas mask intended for the use of train crews when passing through tunnels

A Tunnel Mask for Locomotive Crews

THE mask shown in the accompanying illustration has been designed for use by engineers and other trainmen for protection against gases usually encountered in tunnels and also as a protection against intense heat and escaping steam or from flying glass caused by the breakage of the water glass. Indeed, the mask is expected to protect its wearer under any and all conditions.

The primary object of the mask is to provide a head protecting mask which will supply fresh air to the wearer from a suitable source, such as from a compressed air valve of the locomotive, the air passing from the interior of the mask through a heat insulating chamber formed by a double wall, so that a current of fresh air is continually supplied to the mask and will prevent the heat from passing through the walls. The mask also provides means at the point of entrance of the air into the insulating chamber to muffle the sound incident to such entrance, so that the hearing of the wearer will not be interfered with. Further the mask provides protection for the ears against harsh sounds of the engine exhaust within the tunnel, and the sudden atmospheric change due to the engine's leaving the tunnel.

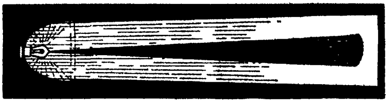
Headlight Focusing Problems

ONE who observes carefully the automobiles that he meets at night will reach the conclusion that a large part of the glare problem would be solved if every driver were compelled to focus his lamps properly. It is hardly an exaggeration to say that in a majority of cases the headlights are improperly focused, causing light to fall where it should not and creating shadows where there should be light.

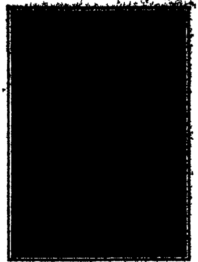
The parabolic reflector in universal use on head lamps has what is known as a focal point and possesses the property that rays of light originating at this point, and reflected from any point whatever of the mirror, will all be sent out along a series of parallel lines. But to take advantage of this property we must have the filament of the lamp at the focal point of the mirror. If the lamp is moved too far forward, the rays are reflected convergently, so that those from the lower half of the reflector take an upward course and those from the upper half pass slightly downward. The rays cross somewhere inside or outside the hollow of the reflector and the resulting illumination is open to two objections: only half of the light falls upon the road which is therefore lighted only half as well as it might and should be; and the other half passes outward and upward at an unnecessary and illegal height, and results in dazzle when the eye of an approaching driver meets the diagonal along which the rays are progressing. No non glare system in the world will eliminate these defects unless the lamp is first properly focused. If the lamp is behind the focal point the ultimate result is the same though differently attained. Here the rays are reflected divergently, so that those from the bottom half of the mirror reach the road and those from the top half pass off into space.

In some cases the reflector is not a parabola—sometimes through manufacturing errors and sometimes through not even pretending to be parabolic. Again, we have lamps where the travel of the bulb, forward and back is insufficient to permit proper focusing. Moreover, if one will inspect a dozen or so bulbs, one will find that the filaments occupy different positions with reference to the base, some being longer than others. This necessitates a fresh focusing with each new bulb that is mounted, and focusing is not without its difficulties. Moreover, it will be found easy to detect the shadow cast by the glass point of the bulb, if this comes in a direct horizontal line with the filament. If the bulb is properly focused, this shadow will not be at all serious—will not in fact, be of larger diameter than the point itself. But if the lamp is out of focus, so that the rays do not leave it parallel, the shadow of the bulb-point, like that of everything else, will be conical in effect, as shown in the drawing herewith.

Most automobile manuals give instructions for the proper focusing of headlights, and if more care were exercised by motorists in general, the benefits derived would be well worth the little time and attention required.



The dark spot in the beam of an automobile headlight, as shown here, is caused by the bulb's being out of focus



This machine prepares and dispenses a cup of hot chocolate at the drop of a coin

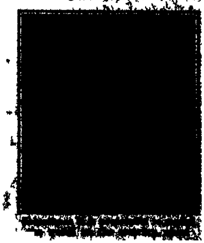
An Automatic Dispenser of Chocolate

FROM Italy comes the accompanying illustration of an automatic machine for dispensing hot chocolate. Instead of having the chocolate all prepared, ready to be served this machine prepares the chocolate from powdered form to the addition of the requisite water or milk and the proper heat, in the space of twelve seconds.

The machine is operated by a small electric motor of one-twelfth horsepower, which performs its work upon the introduction of a coin or a special metal check in the slot. A glass reservoir on top of the machine supplies the milk or water as the case may be. Another reservoir holds the cocoa in powdered form mixed with the required proportion of sugar. Upon the introduction of the required coin or metal check, the correct amount of milk is heated by a steam jet, and the cocoa and sugar powder is introduced and stirred, after which the hot chocolate is delivered into a cup. We have had slot machines for dispensing liquids but none that concocted the drink before serving it.

Placing the Watch on the Steering Wheel

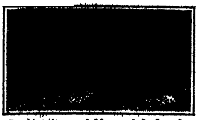
AMONG the latest automobile appliances is a device for holding a watch on the steering wheel of the car. It comprises a simple covered wire arrangement that clamps to the rim of the wheel and holds the watch in such a position that the time may be readily read. It is not always advisable to install a timepiece on the dash of a car, as it necessitates cutting a hole in the wood or metal dashboard, unless a clock comes as regular equipment on the car.



The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M S A E

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Combination sprinkler and flusher for street-maintenance

Two Jobs from One Watering Truck

STREET-CLEANING and street maintenance operations give great scope to the motor-truck manufacturer for the design of valuable combination outfits mounted on more or less conventional chassis, and embodying the apparatus for all sorts of public service jobs. Among such designs an interesting item is the combination watering cart and flusher illustrated. Flushing has ordinarily been a job for a man with a hose but when done so, it results in great waste both of labor and of water The big tank illustrated will sprinkle when sprinkling is in order and when flushing is to be done it will flush—as the action picture shows.

A Motorbus Chair Car

AN innovation in suburban transportation has been inaugurated between Youngstown, Salem and East Palestine Ohio, by the installation of four motorbus chair cars, these corresponding to parlor cars of high-class railroad trains. The chair car de luxe is mounted on a modified truck or special bus chassis, especially designed for passenger service The coaches are entirely of steel and fashioned after the regular Pullman car Individual chairs with luxurious appointments feature this latest advance in motorbus construction They are of wicker, of generous dimensions and are fitted with removable seat and back cushions, making removal for cleaning an easy matter Schedule of service from Youngstown to Salem begins at 9 o clock daily and cars leave Youngstown every two hours until 7 o clock at night, while the first East Palestine car leaves daily at 8 o clock and every two hours thereafter until 8 o'clock at night. The motorbus chair car service has aroused keen interest among transportation men as it can be used for chartered trips and for every sort of social uses as well as in more utilitarian fields.

One-Man Road Grader

THE grader illustrated is an attachment so constructed as to utilize the weight of a popular small tractor as well as the power delivered by it in the operation of the grader The attachments are designed so the installation can be easily made The frame is of standard six inch section steel channel and all castings are of electric furnace steel carefully heat treated It is possible to apply a ton weight on the blade of the grader where it is necessary (to cut hard spots in the road surface) without taking the weight from the traction wheels When the grader is making a heavy hard cut it is impossible to slide the rear of the grader sideways due to the distribution of the weight on the rear wheels.

The grader blade can be tilted and angled to any desired position by the operator from the grader platform In the method of applying the one-man grader to the small tractor it puts 1200 pounds of weight on the front axle which is the same weight as the axle originally carried under the tractor therefore the whole weight of the tractor is thrown to the rear wheels. With loaded rubber wheel equipment the unit weighs $3\frac{1}{2}$ tons giving a wonderful added drawbar pull to the tractor The one-man grader frame is heavily constructed of steel throughout using heavy steel castings where castings are required The grader as well as the tractor is carried on roller bearings having in addition the best possible method of lubrication

When equipped with rubber wheels this combination mounted on roller bearings makes a most ideal equipment for road maintenance work as it will make a speed of eight to ten miles per hour on highways where that speed is required for traveling from place to place and a working speed from one to ten miles per hour at the will of the operator Any speed chosen by the operator is maintained by the engine speed governor The $13\frac{1}{2}$ foot wheel base of the machine gives the unit a wonderful leveling effect on the road as the blade

The one-man road grader

is carried between this long wheel base With the control of the motor left to the governor the operator has only the gear shift and clutch to operate both of which are conveniently handled from the platform and these controls can be handled as easily as from the seat of the tractor After the grader is in motion the entire attention of the operator may be concentrated upon the grading work as the tractor automatically cares for itself therefore one operator can handle the machine with ease No skilled operator is required to handle this machine but the claim is made that any one can handle it perfectly in two or three hours time after limited instruction

The grader moldboard is equipped with a reversible cutting edge so that two cutting edges are realized from each blade The cutting edges used and furnished for the grader are special high carbon heat treated steel to warrant the longest life possible for this rugged work When the grader is used for the maintenance of hard gravel or stone roads or for city or municipal work rubber wheels are used which give the unit the speed required for traveling from place to place and ample traction for that class of work When the grader is used in heavy road grading, as in construction of new roads or subdivision work standard wheels may be used or for greater traction rigid rail tracks are used

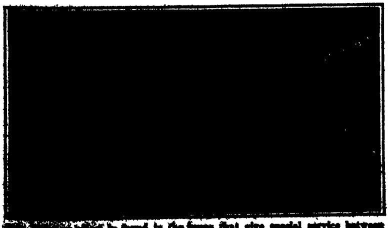
For heavy snow removal the use of this grader gives greater efficiency at lower cost than any other equipment ever produced. This single-unit tractor grader perfectly adapts itself to contractors work as in doing finished grading the $13\frac{1}{2}$ foot wheel base gives a wonderful leveling effect and as the blade is rigidly carried between the four wheels the grade can be kept uniform to a fraction of an inch In working between the forms the grader keeps the road leveled when cut up by trucks and will cut down hard high spots in the grade thus saving many men as it is handled as readily in backing up as in going ahead

This grader is found to work well in muddy conditions as the blade removes the sticky top surface ahead of the driving wheels thereby always giving the traction wheels a finished smooth surface to run on. In making or cleaning out ditches two wheels of the unit are put into the ditch with the blade set at any angle desired and the dirt is thrown up into the road. Hard clay roads can be graded when dry as well as wet as the tractor has plenty of power and weight to cut the hard uneven clay road surface

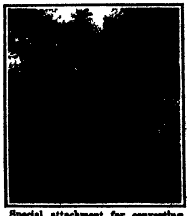
Handling Eggs in Bulk with Minimum Breakage

EVERY day brings reports of new uses for motor trucks but the latest and most interesting as well as novel work in which a motor truck is used comes from Kolise Denmark where Axel Broegaard an egg buyer is using a motor truck to haul eggs in bulk In this country a certain percentage of breakage of eggs is expected even with the use of special crates and every safeguard is taken to protect the fragile freight but in Denmark many buyers handle the eggs in bulk

He has a 3000-pound truck which he loads with 22,000 eggs that weigh approximately 2750 pounds Mr Broegaard calls upon about 400 farmers weekly buying eggs and loading them in his truck The truck body is the regular express type with high flare boards added Between the first nine or ten layers of about 1300 eggs each Mr Broegaard places a layer of straw three-quarters of an inch thick After that no protection is placed between the eggs At one time the truck was carrying 22 000 eggs valued at around $600 which is an average daily load. It is said that the breakage of eggs carried in this manner is no greater than if they were packed in the regular egg cases used in this country After he has taken on about one half a load Mr Broegaard says that he is able to run his truck at full speed on solid tires.



[illegible] is found in the buses that give special service between Youngstown, Ohio, and neighboring cities



Special attachment for converting the tractor to grade work

The Heavens in October, 1923

Another Contribution from Atomic Physics to the Study of the Stars

By Prof. Henry Norris Russell, Ph. D.

MANY times, during the last few years, have we had occasion to speak in these columns of the rapid advances in the interpretation of stellar conditions that follow the work of the physicist, and the rate at which our knowledge increases shows no signs of slackening.

We have already told of the new understanding which has come of the origin of the spectral lines—how the electrons, circling in complex orbits about the central nucleus of an atom, may have not one but many different sets of possible orbits, and how, when a change from one of these states to another happens, the energy set free is radiated (or, perhaps, that required to effect the change is absorbed) in the form of light of a perfectly definite rate of vibration, giving a sharp line in the spectrum.

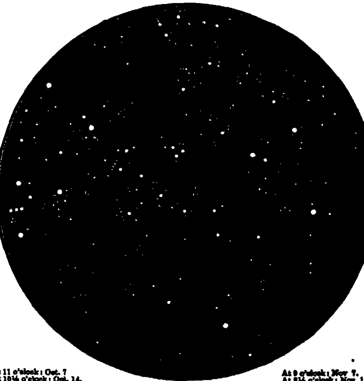
For some elements, such as sodium and potassium, the possible orbits are relatively simple There are but a few dozens of lines in the spectrum and the relations of these have been satisfactorily worked out For others, however, and notably for iron and some similar metals, the spectrum shows thousands of lines, and conditions must be very complex These cases defied analysis till a year or two ago, when a Spanish physicist, Dr Catalan, working in the laboratory of Professor Fowler at London, succeeded in interpreting the spectrum of manganese

Whereas in a simple case like sodium the various orbits occur singly, or in pairs very nearly alike, in manganese they come in groups of three, four or even seven The transitions between them instead of giving rise to double lines, then may produce groups of nine, twelve or even fifteen lines, arranged in a definite but complicated way Once the rules governing such "multiplets" or groups of lines had been found, the way was cleared for further advance The intricate spectra of chromium and molybdenum yielded to investigation—notably at the hands of Dr Kress of the Bureau of Standards, and the latest news is that Dr Walters, also of the Bureau, had succeeded in the attack upon iron, which seemed to be the most impregnable fortress of complexity There is no doubt now that we are within sight of the general solution of the problem of the spectral lines, and that within a very few years we shall have at our disposal a knowledge of the physical changes with in the atom which may give rise to the production of any given line in the arc spectrum

Equally striking has been the progress in the study of the spark spectra, which are given out by atoms from which one electron has already been removed A second electron can then be shifted from one orbit to another, giving rise to a new and entirely different set of lines, and after this has been taken clean away, a third and fourth may successively follow, giving two new spectra Theoretically this process can be continued until all the electrons are stripped from the atomic nucleus, but usually, after three or four are gone, the radiations resulting from further changes are of such short wave length that they resemble X-rays rather than ordinary light The electrons that are loosely enough attached to give rise to the relatively slow visual waves are usually the same as those that operate in ordinary chemical combination, so that the number of different spectra normally obtainable is that which defines the "valency" of the chemist—though violent excitation often brings out one additional stage Thus magnesium has two well-known spectra, aluminum three, and silicon four Many spectra corresponding to the removal of the second electron from an atom are known—the first case being magnesium, studied by Fowler. Recently Paschen, in Germany, has worked out the spectra given by aluminum which is losing its second or third electron (the first has long been worked out), and Fowler in London has identified all four stages in silicon, though only the last has been published in detail.

What It All Means to the Astronomer

The resulting mass of information is so extensive that it takes a good deal of work to become master of it, but this labor will be necessary for the student of the stars, and will repay him well The reason for this is not far to seek. The atmospheres of the stars—in which the absorption lines that fill their spectra are produced—are composed of hot, rarefied gas, and nothing could be more fortunate for the astronomer, for hot rarefied gases are the simplest forms of matter The atoms of the various elements are too violently agitated to combine with one another—indeed, in the hottest stars almost all of them have one electron knocked off, and many two or three. The higher the temperature and the lower the pressure, the larger will be the proportion of atoms in this dishevelled state. We do not have to guess at it, the difficult but powerful investigations of thermodynamics lead to formulæ which should serve as a trustworthy basis for our calculations, which were first made by Saha of Calcutta.



At 11 o'clock: Oct. 7
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.

At 9½ o'clock: October 30.

At 9 o'clock: Nov 7.
At 8½ o'clock: Nov 16.
At 8 o'clock: Nov. 23.

The hours given are in Standard Time.

NIGHT SKY: OCTOBER AND NOVEMBER

An important extension along this line has just been made by two young and able Englishmen, Fowler and Milne, of Cambridge. Consider a set of stars of successively increasing temperatures, and the lines of a given element, such as silicon. At low temperatures practically all the atoms will be neutral (with all their electrons present), and almost all of these will have their electrons in the undisturbed positions, where they can absorb some, but not all, of the lines of the arc spectrum. As we pass to hotter stars, more and more of the atoms will have an electron partially removed and be in a position to absorb additional arc lines, but at still higher temperatures they will lose this electron entirely, and begin to absorb the new set of spark lines, after which a similar process will be repeated—four times in all in the case of silicon.

That such a thing happens was shown by Sir Norman Lockyer, more than twenty years ago, and the knowledge which he gained from the stars has proved of fundamental importance in recent laboratory work. But now, with the aid of theory, it becomes possible to calculate under what conditions of temperature and pressure each set of his lines should be strongest. For the cooler stars—like Arcturus, the sun, or even Sirius—the temperatures are fairly well known from the color of their light. And the pressures in the atmospheres can then be calculated. It comes out surprisingly low—about one ten-thousandth of that of our atmosphere under ordinary conditions. Considering the high temperatures, the density of an average stellar atmosphere must be less than a hundred-thousandth of that of ordinary air. This we would ordinarily call a vacuum, though in a thickness of hundreds of miles it should abundantly suffice to absorb the ordinary spectral lines.

With this value of the density, we may proceed to calculate the temperatures of the hottest stars, which cannot be obtained satisfactorily from their colors, as the latter change very little for great changes in temperature. In this way it is found that the stars with the strongest helium lines (called B2 at Harvard)—like many in Scorpio and Centaurus—have surface temperatures of about 16,000 degrees, while the stars of class BO, like those of Orion's belt, probably run well over 25,000 degrees. A few stars are still hotter, but their temperatures cannot be calculated until further laboratory data can be brought to bear upon the problem.

When the wealth of material which is already in sight or under investigation has been published, and made generally available, we may hope to be able to calculate with considerable certainty both the temperatures and the pressures which prevail in the atmospheres of the stars, and to do this for all the stars, rather than merely for limited groups of them

The Heavens

The familiar outline of the autumn constellations appears on our map. Aquila is low in the west, with Lyra north of it, and Cygnus above the two. The Great Bear swings low on the northern horizon, with the Little Bear above, and Draco on the left, while Cassiopeia and Cepheus are higher, above the pole. Hercules and Gemini may just be distinguished on the horizon—the one caught in the act of setting in the northwest, the other just rising in the northeast. Perseus is high in the northeast, with Auriga below, and Taurus on the right above Orion, which is rising. The great square of Pegasus is high in the south, with Andromeda above on the left. Aquarius, Cetus and Eridanus occupy the huge dull region in the south, while the isolated bright star Formalhaut shines, unattended, low in the southwest.

The Planets

Mercury is a morning star all the month and is best seen on or about the 14th, when he is farthest from the sun. Being, however, only eighteen degrees distant in the sky from the latter, he rises rather late—about 4 45 A. M.; but he should be conspicuous just before dawn.

Venus is theoretically an evening star, but is so close to the sun that there is practically no chance of seeing her,

Mars is a morning star, and in the middle of the month is some five degrees west of Mercury, rising about twenty minutes earlier Mercury, being about ten times the brighter of the two at this time, is the more conspicuous.

Jupiter is an evening star setting about 7:30 P. M. at the beginning of the month and soon becoming lost in the twilight. Saturn is in conjunction with the sun on the 17th, and is invisible. Uranus is in Aquarius, and crosses the meridian at 9:30 P. M. on the 15th. Neptune is in the western edge of the sky, and rises about 1 A. M.

The moon is in her last quarter at 1 A. M. on the 3rd, new at the same hour on the 10th, in her first quarter at 4 P. M. on the 16th, and full at 1 P. M. on the 24th. She is nearest the earth on the 10th and farthest away on the 25th. During her circuit of the heavens she passes through conjunction with Neptune on the 6th, Mars and Mercury on the 8th, Saturn and Venus on the 10th, Jupiter on the 12th and Uranus on the 20th. None of the observable conjunctions is close.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

PATENT FACTS WORTH KNOWING—1

THE right of property which an inventor has in his invention is excelled, in point of dignity, by no other property right whatever. It is equalled, in point of dignity, only by the rights which authors have in their copyrighted books. The inventor is not the pampered favorite or beneficiary of the government, or of the nation. The benefits which he confers are greater than those which he receives. He does not cringe at the feet of power, nor secure from authority an unbought privilege. He walks everywhere erect, and scatters abroad the knowledge which he created He confers upon mankind a new means of lessening toil, or of increasing comfort, and what he gives cannot be destroyed by use, nor lost by misfortune It is henceforth an indestructible heritage of posterity. On the other hand, he receives from the government nothing which cost the government or the people a dollar or a sacrifice. He receives nothing but a contract, which provides that for a limited time he may exclusively enjoy his own. Compared with those who acquire property by devise or inheritance; compared with those who acquire by gift or marriage, compared with those who acquire by profits on sales, or by interest on money, the man who acquires property in inventions, by creating things unknown before, occupies a position of superior dignity Even the man who creates value by manual labor, though he rises in dignity above the heir, the donee, the merchant, and the money-lender, falls in dignity below the author and the inventor Side by side stand the inventor and the author Their labor is the most dignified and the most honorable of all labor, and the resulting property is most perfectly theirs.—Walker on Patents, section 152

Pertaining to Aeronautics

AIRPLANE.—H. COAKLEY, 207 W. 14th St., New York, N. Y The invention relates to an airplane having superposed supporting units respectively angled and intersecting in dihedral and reverse dihedral relation. The device is characterised by the central portion of the lower unit having dihedral angularity and lateral extending portions of said units being engaged at their points of intersection to constitute an integral formation for the entire airplane. Among the objects is to minimize head resistance such as is produced by struts used in connecting and bracing superposed wings. (See Fig. 1.)

PROPELLER.—L. DE MONGE, 82 Boulevard de Picpus, Seinè Department, Paris, France. The invention relates to aircraft propellers constructed of wood, and has for its object a particular outline for this class of propeller whereby the efficiency of the same shall be increased. The advantageous result is partly due to a particular tapered form which is given to the ends of the propeller blades.

Pertaining to Apparel

UNDERGARMENT — J H. MOFFAT, 5511 University Ave., Indianapolis, Ind. The object of the invention is to provide an article in the form of a two-piece union suit, the two pieces of which may be worn either together or separately A further object is to provide a union suit the two pieces of which are formed of material of different weight. In fact formed of different fabrics of varying weights and textures.

CHILD'S GARMENT.—D LANG, 85 5th Ave, New York, N. Y This invention has for its object to provide a garment which to all appearances is a single piece garment of the romper type, involving a skirt portion to which a bloomer or pants portion is detachably connected in a simple and efficient manner so that the pants portion can be very easily applied and removed.

GARMENT.—A. ROCKS, 859 Beck St., Bronx, N. Y. An object of this invention resides in the provision of a garment in the nature of a corset the parts of which may be adjusted to snugly encircle the parts of the wearer's body and to conform to the peculiarities and irregularities thereof. A further object is to provide a corset which efficiently supports the back and retains the bust in a desirable manner, and also confines the hips of the wearer, to cause them to present a rounded appearance.

Electrical Devices

SWITCH.—R. S. TOWER, Cottage Grove, Oregon. The invention has for its object to provide a switch especially adapted for controlling the circuit of electrically heated irons, wherein the switch is of simple and inexpensive construction, and capable of being applied to the usual form of iron, without change to the iron. A further object is to space the connection away from the heated portion of the iron, to prevent injury to the switch.

TROLLEY REPLACER.—M. M. SYKES, 1641 Folsom St., San Francisco, Calif. The particular object of this invention is to provide means in connection with the trolley of an electric car for reengaging the same with the trolley wire if it becomes disengaged A further object is to provide a second wheel adapted to engage the wire whenever the trolley jumps off the same, this second wheel being so constructed and disposed that it will automatically work the trolley back into its operative position without requiring the attention of an operator (See Fig 2.)

DEPOLARIZER. — B H. TEITELBAUM, c/o Bright Star Battery, 310 Hudson St., New York, N Y The invention relates to a dry battery, including zinc chloride as an ingredient in the electrolyte. An object is to provide a dry battery which will have a low internal resistance and consequently a high short circuit amperage, and will have a large service capacity, and remain out of service a long period without deterioration

Of Interest to Farmers

TRACTOR.—L. J MITCHELL, Huntington, W Va. The object of this invention is to provide a tractor of the line of control type which is easy to manipulate and flexible in its operative movements, which is simple in construction and capable of drawing a relatively large load and turning around in a comparatively small space A further object is that the engine associated with the tractor may be utilized for belt work if so desired.

TRANSPLANTING DEVICE. — H. D. ELLIOTT, Tabor, N C. The invention relates to devices particularly adapted for transplanting tobacco, cabbage, tomato plants and the like. The object is to provide a relatively simple device which will serve to permit the plants to be efficiently deposited one at a time in the required depressions and to pack the loose soil so as to prevent the same from falling backward, the device insuring the proper starting growth and producing a healthy plant.

PLOW ATTACHMENT FOR TRACTORS. — B W MORTON, Williston, Fla. This inventor has been granted two patents of a similar nature The objects are to provide an attachment which may be quickly attached to a tractor in a position that it may be easily observed during operation by the driver of the tractor It is also an object that the plow be adapted to make a relatively broad furrow A further object is to provide a plow attachment particularly adapted for operating upon ground where roots or other obstructions are to be contended with.

WHEELED TRACTOR. — B. W MORTON, Williston, Fla The inventor has been granted two patents of a similar nature, the object being to provide a cutter attached to the wheels of a tractor and serve to cut the earth to facilitate the breaking or plowing thereof, and also serve to sever obstructions which may impede progress. It is a further object that the cutter may be durable and the attachment easily secured to the tractor wheel.

COLTER ATTACHMENTS FOR TRACTORS. — B. W MORTON, Williston, Fla This invention more particularly relates to the manner of attaching a colter to a tractor, the purpose being to provide means whereby the colter may be subjected to a yieldable pressure for causing the same to penetrate the soil over which it may operate An important object is to provide means whereby the colter may be rigidly held against upward movement and thus establish a certain depth at which it must penetrate the soil The device is adjustable and may be lifted from the earth when desired inoperative.

Of General Interest

FLOOR AND WALL MOP — J F KELLY, Elkins, W Va. Among the objects of the invention is to provide a simple and efficient mop adapted to hold a suitable mop head of cloth such as tufted fabric provided with a pile surface, or loose strands doubled upon themselves, and in which provision is made for rinsing the mop in a bucket or for wringing the mop, the cloth being adapted to be rendered taut when in a position for use.

FLY PAPER HOLDER. — D LEVY, 507 E. Mt Eden Ave., Bronx, New York. An object of the invention is to provide means for supporting a roll of fly paper in such manner that there is no danger of a person becoming entangled in the paper, and to provide means for normally feeding the roll after the exposed portion has served its purpose. The device may serve the function of a sheet, or may be suspended upon the wall.

PRESSURE-CONTROLLING DEVICE. —V L. ADAMS 603 S 8th St., Waco, Texas. The general object of the invention is to provide a device which shall enable an operator to regulate the various expansion valves of an ice or refrigerator plant so that the refrigerating fluid admitted into the various refrigerating sections may be known and thereby have the sections operating under an equal degree of refrigeration.

CIGARETTE HOLDER.—W JOSSELYN, Carmel City, Calif The invention particularly relates to a cigarette or cigar stub ejector device for use in connection with cigarette or cigar mouthpieces The object is to provide a device which may be inserted in the holder for forcibly removing the stub from the mouthpiece. It is also an object to provide a device which acts to clean the opening channel as it ejects the stub. (See Fig 3.)

GRAVITY CORRECTION DEVICE.— W R. HOUNSELL, Okmulgee, Okla. This invention relates to calculating devices. An object is to facilitate the correction of gravities of liquids lighter than water and observed at varying temperatures by providing means operable to indicate equivalent gravities at a determined constant temperature. The device can be operated quickly and the results accurately indicated.

FOLDING TENT —B. B DUDLEY, Visalia, Calif. The object of this invention is to provide a tent of substantial proportions that can be conveniently folded into a small bundle adapted to take up little space in a camping outfit. A particular advantage is that the tent provides sufficient head room for a person or a number of persons to stand upright and have the comfort of a room in a house.

AUTOMATIC PENCIL SHARPENER. —H M MITCHELL, 1205 Hyde St., San Francisco, Calif Among the objects of the invention is to provide a convenient means for sharpening a pencil that will work automatically upon the insertion of the pencil. A further object is to provide a sharpener that will give either a chisel point, as preferred by draftsmen, or a needle point, as in every-day use A still further object is to provide a sharpener in which emery cloth is used for putting a fine finish to the lead while automatic cutters are employed for removing the wood (See Fig. 4)

SPOOL.—H O TAFT, 60 Adams St., Burlington, Vt. The invention relates particularly to bushing and retaining means for spools and has for an object to provide a construction which is simple but very effective in retaining the parts together A further object is to provide a securing member which will retain the bushing in place without the use of glue or other adhesive.

FILTER BED FOR SEWAGE DISPOSAL.—W T BURTIS, Glen Head, Long Island N Y An object of the invention is to provide a filter bed for the final disposal of waste water after grease and other solid

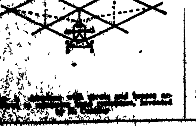


Fig. 1. Airplane with struts and braces ... invented by H. Coakley

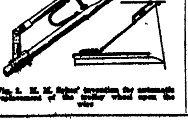


Fig. 2. M. M. Sykes' invention for automatic replacement of the trolley wheel upon the wire

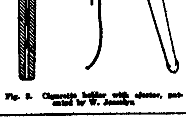


Fig. 3. Cigarette holder with ejector, patented by W. Josselyn

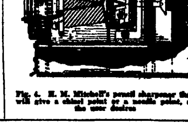


Fig. 4. H. M. Mitchell's pencil sharpener that will give a chisel point or a needle point, as the user desires

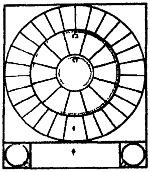


Fig. 5. R. H. Irwin's newly designed garage in which backing of cars is practically eliminated

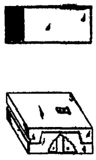


Fig. 6. A novel way of packaging folded tissue paper for lavatories, devised by L. J. Arms

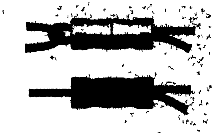


Fig. 7. This clever device for joining the ends of a clothesline is the invention of L. [illegible]

substances have been intercepted in a system of cesspools, which filter bed positively insures the return of the waste water into the ground in a purified state at a point where it will be absorbed, without the necessity of going to the expense of a large amount of excavating work.

VACUUM BOTTLE.—A. G. Hale, c/o Geo. H. Haldy, S. W. corner 4th and Race Sts., Cincinnati, Ohio. This invention has for its object to provide a vacuum bottle having means for holding a receptacle in position to permit a liquid to be poured therefrom and for absorbing shocks and jars incident to the service for which intended without transmitting such shocks to the receptacle. The device is of relatively simple construction, and may be inexpensively manufactured.

BUILDING CONSTRUCTION.—R. H. Irwin, P. O. Box 29, Portland, Oregon. The invention aims to provide a building especially adapted for use as a garage, or for storage purposes. The object is to construct a building in such a manner that space heretofore wasted will be used to the fullest extent and that vehicles stored therein will be readily available and that backing will be practically eliminated, the vehicles after entering the building being placed upon a turntable and brought in direct contact with the compartment to be occupied. (See Fig. 5.)

REFLECTOR.—A. Matisse and C. A. Matisse, 270 E. 133rd St., New York, N. Y. The general object of this invention is the provision of a cheap and efficient reflector for throwing a yellow ray. The object is accomplished by providing a yellow glass and applying to one face a reflecting composition comprising a gold salt and superimposing upon the gold salt a silver salt and a metal which serves to increase strength and stability, and which is applied by an electroplating process.

WATCH GUARD.—P. H. Nolting, 300 Communipaw Ave., Jersey City, N. J. Among the objects of this invention is to provide a guard which is equipped with means for preventing the accidental loss of a watch from a pocket. A further object is to provide a guard which can be readily sewed into a pocket and which will be simple, durable and efficient in use and comparatively inexpensive to manufacture.

SEALING-WAX STICK.—A. Nadler and J. R. Kinghorn, 202 St. John's Place, Brooklyn, N. Y. The principal object of the invention is to provide a sealing-wax stick which when lighted will retain the flame thereon and eliminate the necessity of constant lighting. In the composition of the wax stick a quantity of artificial silk or cellulose fibrous material is used, said fibrous material serving to insure a rapid combustion which almost entirely consumes itself, the ash or carbon being reduced to a minimum, the flame remaining on the stick and burning to melt the wax.

STROBOSCOPIC APPARATUS.—[illegible] J. H. Elverson, London Bridge Reading, England. The object of the invention is to provide a stroboscopic apparatus for use in studying the movement of bodies moving at relatively high speeds in a periodic manner. A further object is to provide an apparatus in which the stroboscope is driven at a speed differing slightly from the speed of the moving body, so that the mechanism appears to traverse its path at a relatively slow speed.

LOCKING JOINT.—L. W. Murphy, 48 Lester St. West Haven, Conn. An object of the invention is to provide a locking joint which will take the place of the ordinary mortise and tenon dowel joint, in fact may be utilized in practically any place where it is expedient to join the ends of two members in angular relationship. The joint is particularly adapted for use with screen frames and similar structures.

REVERSIBLE CUFF.—S. H. Wilson, c/o S. N. Wilson, Graders Bank Bldg., Lexington, Mo. This invention relates to cuffs for shirts, and more particularly to the kind known as "French" cuffs, designed for use with shirts of soft material such as silk madras or the like which are intended to be only slightly starched, so that they may fold without breaking along the line of fold. The object is to provide a cuff intended to be permanently attached to the sleeve, but which is reversible, and having the same appearance whether folded normally or reversed.

LOCK.—R. R. Raymond, 104 W. 52nd St., New York, N. Y. The invention relates to a lock which is particularly adapted for use in connection with a telephone instrument, although not limited to this application. This device when in applied position on a telephone instrument will absolutely preclude any danger of the instrument being used by an unauthorized person. The lock is of simple construction and will in no way damage the instrument in its connection or disconnection.

CARTON FOR FOLDED TISSUE PAPER.—L. J. Arms, 428 Noe St., San Francisco, Calif. The invention relates to means for packing and dispensing folded tissue papers, such as are commonly used in lavatories. The object is to provide a carton which will serve the purpose of a wrapper as well as a dispensing box, thereby allowing the paper to be placed in the carton by the manufacturer and withdrawn by the person using the paper, without necessitating any handling on the part of an attendant. (See Fig. 6.)

CLOSURE FOR TUBES.—C. J. Hauk, Jr., 300 Madison Ave., New York, N. Y. The invention relates to collapsible tubes. It is one of the objects to provide a closure in which the ordinary screw-thread is dispensed with, the tube neck and cap being so constructed as to lock with a partial turn. A further object is to provide a cap which cannot be entirely removed, thereby preventing accidental loss of the cap.

METHOD AND APPARATUS FOR PRODUCING DISTORTED IMAGES.—G. L. Chanier, c/o Pathe Exchange, 1 Congress St., Jersey City, N. J. This invention has for an object the provision of a simple and efficient means whereby moving pictures can be taken of a given object so that the image of this object in a reflector can be distorted in any desired manner to produce the required effect in the camera. The apparatus is inexpensive to make and easy to operate.

STREET INDICATOR.—W. M. Flewelling, Box 137, Healdsburg, Calif. The invention relates to indicators adapted for use upon street cars. An important object is to provide a street indicator having simple means whereby the same may be adjusted to indicate to the occupants of the car the next stop, and when the car reaches the end of the line the indicator may be conveniently reversed.

CUE TIP.—J. L. Doerschel, 78 Weber St., Kitchener, Ont., Canada. An important object of the invention is to provide a cue tip having means whereby the same may be securely connected to a cue without employing glue and which when applied is securely held in position until worn out. The tip may be applied in a few seconds, and is of simplified construction and cheap to manufacture.

LEMON AND LIME SQUEEZER.—J. D. William and J. R. Bolton, Sulphur Springs, Texas. The object of the invention is to provide a device of this character which is adapted to carry out with facility the cutting of the lemon or lime into sections and the squeezing of such sections as may be desired. The device is of simple and durable construction and neat in appearance.

FISHGIG.—I. E. Malone, R. No. 2, Beeville, Texas. This invention relates to bows and arrows especially adapted for use in fishing. An important object is to provide a bow wherein the body is of rigid construction and tensioning springs are provided for imparting force to the arrow. A further object is to provide means for supporting the return cord in such manner that it may readily unwind when the arrow is shot.

VANITY CASE.—A. C. Maynard, Associated, Cal. Among the objects is to provide a vanity case that is particularly pleasing in looks and practical in the arrangement of its partitions, that is provided with a mirror all around and has convenient means for carrying the same, the case being conveniently carried by a flexible strap secured to rigid metal members.

ENVELOPE MOISTENER.—A. J. Schaub, Sr., 1522 55th Ave., Oakland, Cal. This invention is designed for the purpose of facilitating the work of sealing envelopes in large quantities. Among the objects is the provision of means for opening the envelope with the moistening means, and means for draining surplus moisture from the envelope after the latter has passed the moistening means.

LIFTING DEVICE.—F. Fahsbender, 187 Hazel St., Paterson, N. J. The aim of this invention is to provide a receptacle lifter by means of which a receptacle may be readily gripped, and subsequently lifted and carried without an operator endangering his hands either by heat or the splashing of acids or similar substances contained in the receptacle. The device is intended to reduce the danger of breakage of the receptacle.

BUILDING CONSTRUCTION.—J. N. MacDonald, 22 Scituate St., Arlington, Mass. The object is to provide a hollow wall construction, wherein the cost is reduced to a minimum amount of time fastening means being provided for holding the blocks in a wall together, which will do away in a great measure with the use of mortar. The construction is damp-proof, simple and durable.

LAUNDRY BAG SUPPORT.—E. R. Knorr, Indian Field Road, Greenwich, Conn. An object of the invention is to provide a device which will support a laundry bag in either closed or open position. A further object is to provide a form of bag supporting frame to which a bag may be removably attached and by which the user may keep track of the articles deposited so that a laundry list may be compiled by referring to the indicating means.

CONCRETE FORM.—W. J. [illegible], 45 Holland Ave., Floral Park, N. Y. An object of the invention is the provision of a method for forming a plurality of sections of cementitious material in a simple manner so that they may be quickly assembled into a plurality of forms for building purposes. The form provided is capable of adjustment for such building structures as [illegible] columns, posts, [illegible].

SWING.—[illegible] Ave., Brooklyn, N. Y. Among [illegible] is to provide a motor-driven swing which will do away with the manual exertion ordinarily necessary to operate a lawn swing, and to provide a swing which will be strong and serviceable, simple and of attractive appearance, in full size for outdoor use, or may be manufactured as a toy.

CALCULATOR.—W. M. Frazer, Bristow, Okla. The invention relates to calculators adapted for use in the sale of oil or other liquids by liquid measure. An object is to provide a calculator with which equivalents on the Baumé and specific gravity scales may be told at a glance, and the amount of change in the specific gravity of oils due to temperature changes may be directly read. The device is simple in operation and occupies a small space.

FLY SHOOTER.—B. Kennedy and L. Saiger, 168 No. Main St., Gloversville, N. Y. The invention relates to a fly shooter in the form of a pistol which may be employed to kill flies, or the like. The device is constructed to resemble a pistol as to stock and handle, the striker is folded back on the stock, and is adapted to swing forwardly from the stock when released by the trigger.

SAFETY PIN.—J. H. Cargill, 88 Lafayette St., Jersey City, N. J. The invention has for its object the provision of a safety pin which positively precludes accidental retraction of the pointed extremity from the article to which it is applied in event of the displacement of the same from the point engaging catch. A further object is to provide a pin which affords a maximum capacity in a pin of minimum size. The pin is of simple construction and inexpensive to manufacture.

BOTTLE STOPPER.—H. J. Smallwood, 223 Richland Ave., San Francisco, Calif. The particular object of the invention is to provide a stopper for milk bottles and the like, that will make a good air-tight closure for the bottle and at the same time provide a spout through which the milk or other liquid may be discharged. A further object is to provide a cap in combination with the stopper which can be easily removed without the use of tools or sharp instruments.

DRIP-PAN ALARM.—A. Wallace, [illegible] E. 75th St., New York, N. Y. The invention relates to drip-pan alarms adapted to be set on the edge of a pan, and more particularly to an alarm operated by a float adapted to cause an audible signal to be sounded. The general object is to provide an alarm in which the bell clapper is controlled by the float as it is raised by the rising of the water in the pan.

CLOTHESLINE FASTENER.—L. A[illegible], 206 [illegible] Ave., West Hoboken, N. J. Among the objects of the invention is to provide a fastener to connect two ends of a rope, the device being so constructed that by looping the ends they may be locked against movement. A further object is to provide a [illegible] [illegible] the interlocking ends are [illegible] [illegible]. (See Fig. 7.)

PHONOGRAPH [illegible]

[illegible]

[illegible] the invention no matter what [illegible] of the [illegible] surface.

HINGED COVER FOR CONTAINERS. —F. W. [illegible], c/o Washburn Electric Light and Power Co., Washburn, Wis. An object of the invention is to provide a device having a hinged cover in which the cover may be moved away and locked, though an obstruction may be disposed intermediate the cover and the opening of the container, without injury to the cover or container. A further object is to provide a device in which the cover may be closed and locked, or opened with one hand.

CLEANING DEVICE.—J. B. Kirk, Iola, Kans. The invention relates to a cleaning device for removing carbon from apparatus permitting of the distillation of carbonaceous material. The device includes a trough, a conveyor and shafts adjacent the base of the trough and centrally positioned within the same, and means carried by the shaft for actuating the same, and the conveyor.

IMPLEMENT FOR WRITING.—W. F. Kelly, 915 W. Front St., Greenwood, Miss. Among the objects of the invention is to provide a writing implement in the form of a pencil having a heated marking element adapted to be used for writing upon paper or the like without scratching, and to produce clear and legible writing. The pencil comprises a casing, a storage battery positioned therein, a scoring point and means whereby the current from the battery may be caused to heat the scoring element.

MEMORIAL TABLET AND GRAVE MARKER.—E. D. Hamberg, 405 No. 3rd St., Montevideo, Minn. The invention relates more particularly to casket plate which may be utilized as a memorial tablet either permanently or temporarily, and after temporary use as a tablet or grave marker, the plate having a substantially flat body with a bendable eye upon its rear face, also a bore at one end for the association of a detachable stake.

BOAT.—A. C. Dale, 824 Gravier St., New Orleans, La. An object of the invention is to provide propelling means in the form of an endless device arranged with a series of blades or paddles, together with means for driving same at a uniform depth in the water, and to provide a hull construction designed to insure uniform speed when traveling in a rough or smooth sea, to lessen the draft of the boat, as well as to obtain greater speed for the power expended.

COLLAPSIBLE STRUCTURE. — S. White, 337 Union St., Brooklyn, N. Y. The invention is adapted for employment in a structure which may be used as a garage, in camping and for various other purposes, as, for instance, a temporary collapsible top for the body on a freight car. The general object is to provide a structure composed of sections adapted to telescope and arranged so that they may be turned over on the base of the structure thereby possessing a maximum of compactness.

VANITY CASE.—W. G. Kendall, 118 Market St., Newark, N. J. One of the objects of this invention is to provide a small, compact vanity case adapted to carry a plurality of cosmetics, such as face powder and rouge, in the form of compacts. It is a further object to so mount these compacts that either may be positioned in such a manner that access thereto may be readily obtained, and to provide a lid structure with means for retaining a mirror.

DISPLAY RACK.—O. J. Hotaling, 23 Melrose Ave., East Orange, N. J. The invention relates to a rack designed for holding newspapers, magazines or periodicals in displayed position at newsstands. An object is to provide a display rack in which the pocket forming elements are adjustable and capable of being swung to a collapsed position whereby the rack will occupy a minimum amount of space when not in use.

PIPE DRAIN.—A. Hess, 48 W. 23d St., New York, N. Y. An object of this invention is to provide a simple construction which will drain a smoking pipe at all times. Another object is to provide a drain which may be easily inserted or removed and will not mar the appearance of the pipe. A further object is to provide a drain which automatically collects the saliva and presents means for easily cleaning the pipe.

MASSAGE DEVICE.—J. O. Linden, Box 491, Albuquerque, N. M. An object of this invention is to provide a massage device adapted to receive temperature-regulating agents and to provide means for protecting the hands of the user from being injured by the temperature regulating agents. A further object is to provide a device which is of simple and durable construction and neat and attractive in appearance.

INDEX FOR FILING DEVICES.—C. U. Finocchiaro, 1528 Amsterdam Ave., New York, N. Y. The object of this invention is to provide an index for filing devices having a plurality of guides in which cards with the titles of records or other articles filed may be disposed, the guides being positioned so that the titles of the articles filed may be readily visible. Another object is to secure the guides in a drawer with a glass front which will permit the user to easily examine the cards without pulling out the drawer. (See Fig. 8.)

Hardware and Tools

SHOVEL.—A. Weickman, Harrison Ave., Harrison, N. Y. One of the principal objects of this invention is to produce a shovel which in addition to serving in its usual capacity for introducing coal to a furnace or stove and removing the ashes therefrom, functions as a sieve for separating the dust or dirt from the coal and removing the cinders from the ashes. The device is strong, simple and inexpensive to manufacture. (See Fig. 9.)

HYDRAULIC JACK.—A. Paoli, c/o R. Paoli & Co., Hancock, Mich. This inventor has been granted two patents of a similar nature. The object is to provide a hydraulic jack that is relatively simple in construction and operation. A further object is to provide a device having a liquid-holding receptacle and means for returning the power liquid to the receptacle when the work-engaging member of the device has been raised to a predetermined height, whereby the work-engaging member of the device cannot be moved out of operative position when the operation of the device is continued. A further object is to permit the escape of air from the liquid used in the device without permitting any of the fluid to pass therefrom.

IRON REST AND CLEANER.—L. D. Grenda, 2000 W. Division St., Chicago, Ill. This invention relates generally to stands for flatirons, and more particularly to an iron rest having means for accomplishing the polishing and cleaning of the work-engaging surface of the iron. An object is to provide a simple, inexpensive and effective means for supporting a heated flatiron and for precluding the marring of the surface of the same.

DOOR LOCK.—S. R. Stevens, 24 Stone St., New York, N. Y. The invention relates to a door lock of a semi-automatic nature which is adapted for use in connection with all types of swinging doors, but particularly to what is commonly known as a revolving door, such as are employed in banks, hotels, etc. A further object is to so construct the lock that when once actuated it will have to be released by a person from the outside of the building, thus precluding the possibility of the bandit or intruder operating the same, or intimidating the occupants so that they will release the lock.

PNEUMATIC JACK.—W. F. Kelly, 915 W. Front St., Greenwood, Miss. One of the principal objects of the invention is to provide a jack having telescoping sections which may be extended under the action of compressed air, and in which the air may be quickly dispelled to allow of collapse into normal inoperative position. A further object is to provide for holding the jack in raised position against collapsing movement, and to provide an automatic lowering movement. The device may be built in sizes ranging from one thousand pounds, for automobiles, to fifty tons, for railroad work. (See Fig. 10.)

LEVEL AND PLUMB.—D. W. L. Frank, 312 Masonic Temple Bldg., Mobile, Ala. The invention relates to measuring instruments. An object is the provision of a construction which is equally adapted for application with a straight-edge or square whereby to secure proper levels and plumbs and to determine the degree, pitch, slope or angle of any surface or surfaces. A further object is to provide a base-plate and superposed thereon an adjustable plate carrying a spirit tube and graduations in order to ascertain the angles and distances between points.

REVERSIBLE BOLT LOCK.—W. N. Sauerbrei, c/o Wilson Bohman, Inc., 758 Lexington Ave., Brooklyn, N. Y. The object of the invention is to provide a bolt lock or latch arranged to permit of conveniently reversing the bolt to allow the use of the lock on doors swinging either inward or outward. Another object is to permit of reversing the bolt without disassembling the lock.

Heating and Lighting

STOVEPIPE REDUCING JOINT.—M. Ludwig, 2nd and Ferry Sts., Albany, Oregon. The invention has for its purpose to provide a simple and inexpensive joint section made of a single piece of sheet metal which is adapted to securely connect stove pipes having different cross-sectional contours, and which is very readily adjustable to connect stovepipes of different and varied diameters.

SIGN.—F. E. Brown, 1312 9th Ave., Seattle, Wash. The invention relates to illuminated signs adapted for use as an advertising medium. An important object is to provide an illuminated sign having means whereby letters or other characters may be detachably applied to a more or less translucent body and effectively illuminated so that the characters may be readily seen. A further object is to provide a background which will attract attention.

WATER-TUBE BOILER.—F. C. Stimmel, c/o Casey Hedges Co., Chattanooga, Tenn. The object of the invention is to provide a water-tube boiler more especially designed for high pressure steam service and capable of taking care of overload conditions. Another object is to gradually heat the incoming feed water and thus reduce expansion strains on the tubes to a minimum, and to maintain a uniform tube area, insuring a proper circulation of the water.

BURNER.—E. E. Cornwell and J. H. McCready, 622 E. 6th St., Okmulgee, Okla. Among the objects of the invention is to provide a gas burner wherein the proportion of air and gas may be conveniently regulated so as to insure a generation of a highly combustible mixture and under varying conditions thereby insuring at all times a generation of a high degree of heat and in general an efficient operation of the part of the burner.

FOLDING COOK STOVE.—M. Sussman, 1028 Westminster Ave., Detroit, Mich. An object of this invention is to provide a cook stove which when not in use can be folded to occupy but relatively small space within a casing, countersunk in the wall of a room. A further object is to provide a stove comprising any desired number of burners and a collapsible oven, which will efficiently perform their functions when in use. The stove is especially designed for use where housekeeping is done in small apartments.

WATER HEATER.—G. Moskalozek, c/o J. Strenlens, 54 Old Broadway, New York, N. Y. The invention has for an object the provision of an automatic water heater which is simple in construction and operation. Another object resides in the provision of means whereby the heating fluid is cut off automatically whenever the flame, especially the pilot flame, goes out, there being provided thermostatic means responsive to changes in temperature to actuate magnetic means to close off the gas valve under predetermined conditions.

Machines and Mechanical Devices

PRESS.—J. I. Pogue, R. No. 1, Box 32, Omak, Wash. An important object of this invention is to provide a fruit box press and lidding machine having simple means whereby a pair of pressure arms may be brought into engagement with the lid of the fruit box with a uniform degree of pressure and will not in any way interfere with the freedom of action of the nailer. A further object is to provide means whereby the box is tilted upon completion of the nailing onto a conveyor.

GRAIN ELEVATOR.—C. Mettler, Sr., Menno, S. D. The object of the invention is to provide a grain elevator in which excessive pressure or "choke up" and undesirable overflow resulting from clogging of the system are automatically prevented, the excessive grain being received and carried off by means provided therefore. A further object is to provide an elevator which is of simple and durable construction reliable in operation and easy to install. (See Fig. 11.)

WATER PUMP.—W. Larson, Kingsburg, Calif. The invention has for its object to provide a construction capable of lifting a large volume of water quickly a short distance. A further object is to provide a water pump which may have the operating parts bodily removed from one well and inserted into another with a minimum effort.

CONCRETE BLOCK MACHINE.—W. A. Whitfield, Asheville, N. C. Among the objects of the invention is to provide a cement block manufacturing machine having means whereby the sides and ends of the mold blocks are swung into position by the operation of a single lever so that the manufacture of the blocks is greatly expedited. In this machine the use of cores is dispensed with, permitting the formation of a block of more than usual strength.

MACHINE FOR FORMING PNEUMATIC TIRES.—B. De Mattia, c/o Munn, Anderson & Munn, 233 Broadway, New York, N. Y. This invention has for its object to produce a machine in which a cylindrical tire blank built up of superimposed layers of bias fabric, and suitable cushioning and tred strips, with a bead in-

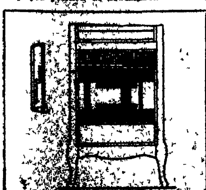


Fig. 8. [illegible]

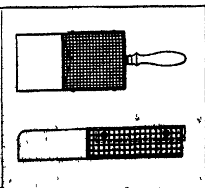


Fig. 9. New furnace, tool, shovel, and stove combined, invented by A. Weickman

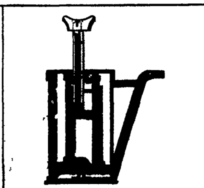


Fig. 10. More nearly automatic action distinguishes W. F. Kelly's pneumatic jack

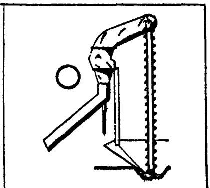


Fig. 11. C. Mettler's grain elevator, designed to prevent choking and overflowing

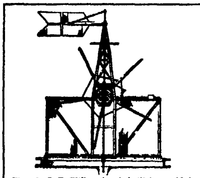


Fig 12 I F Willman's windmill is provided with better means for self adjustment to the wind

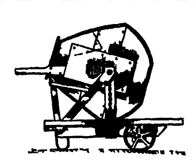


Fig 13. Hand-operated rotary concrete mixer designed by G W Adams

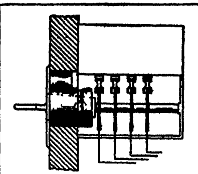


Fig 14 Automobile lock that locks automatically when the ignition is turned off, patented by C. A. Habenicht

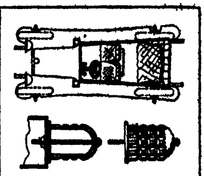


Fig 15 Novel hub-cap attachment, put out by C. F Reilley and J. J. Ludwig

corporated in its opposite edges may be expanded and shaped to conform to the conventional shape of shoes or casings for the subsequent operation of vulcanization

WINDMILL —I F WILLMAN Muleshoe Texas The invention especially relates to windmills adapted for use in operating wells An important object is to provide a wind mill having means whereby the same is positioned with relation to the wind and where by the same may be thrown out of gear during a storm or high wind A further object is to provide a windmill having a pair of wooden or metal wheels which by a novel arrangement are operatively connected to a pitman rod or drive shaft (See Fig 12)

ROLL COVER —C NORDELL Gilbertville Mass This invention relates to rolls for textile machines and more particularly aims to provide a roll cover of U shaped cross section, mountable or demountable relative to an unflanged roll but without requiring a multi part roll or special machinery tools, temperatures or chemicals

AIR COMPRESSOR —D C BAKER, 1900-12 Park St Alameda Calif An object of the invention is to provide a construction of this character whereby air may be pumped economically and efficiently into a storage container A further object is to generally improve the compressor in various particulars whereby the cooperative relation of the valve and chambers provided in the cylinder heads and the position of the main intake and discharge function in a manner to act on the air in stages that are designed to promote facility and precision in the operation of the device

BRUSH MAKING MACHINE —U S PERKINS 810 W Washington St., Lebanon Ind Among the objects of the invention is to provide a device for removing the soft cellular substance from the harder fiber of a palmetto root for making brushes or the like and to provide a device for automatically ejecting the product when finished from the machine A further object is to provide a device which is capable of greatly increasing the production of brushes

SAW SHARPENING AND SETTING MACHINE—T H LAUBY Hotel Atlas 4th and Mission Sts San Francisco Calif One of the objects of the invention is to provide a machine for holding and feeding a saw to present the same to reciprocating files to accurately sharpen the teeth whereby the necessity of jointing the same is eliminated A further object is to provide mechanism for intermittently feeding the saw and regulating the extent of movement whereby to afford a wide range of adjustment and render the machine applicable to saws of various sizes

CONCRETE MIXER —G W ADAMS, 158 Rockwood Court San Antonio Texas. An object of the invention is to provide a mixer adapted to be operated by hand to have a semi rotative movement. A further object is to provide a mixer of large capacity which is provided with mixing elements so located as to insure the thorough mixing of the concrete so that the latter can be discharged directly into the forms The machine is made entirely of steel yet is comparatively light and easily movable from place to place (See Fig 13.)

Medical Devices

SYRINGE —O O R. SCHWIDETZKY, c/o Becton Dickinson Co Rutherford N J The object is to provide a syringe arranged for convenient filling and refilling with a serum notably one that is used for local anaesthesia Another object is to permit of refilling while the syringe is applied without danger of admitting air or other foreign matter into the barrel and to prevent the injected fluid from being withdrawn from the vein into the syringe during the refilling operation

TRUSS —G A BERRY, Modesto Calif This invention relates to a truss for hernia and has for its general object to provide a construction that will result in the truss being firmly maintained against displacement when applied and that will afford the minimum discomfort and rubbing action of the wearer

Prime Movers and Their Accessories

CARBURETOR —E E ECKERT, 1316 N Dearborn St. Chicago Ill An object of the invention is to provide a carburetor having means for intimately commingling air in flammable hydrocarbon and air in order to form a uniformly efficient homogeneous explosive mixture A further object is to provide a device adapted to be applied to an internal combustion engine of ordinary construction and to provide means to regulate the volume of air entering into the explosive mixture and to ensure a maximum power with a minimum of fuel consumption

INTERNAL COMBUSTION ENGINE —H J FLEDDERMAN, Box 63 Yreka Calif The invention has for its object to provide an engine having combustion chambers at each end of the cylinder together with means for supplying fuel to the ends and permitting the waste products to exhaust, the inlet and exhaust ports being controlled by sleeve valves mounted to reciprocate and controlled by the movement of the piston each end of the cylinder having igniting devices

SPARK PLUG —W F JENKINS 1814 Hanover Ave Richmond Va One of the foremost objects of the invention is to provide a spark plug screw head of unusual construction, among its functions being to scrape away foreign matter from the terminal plate of the connected wire as said head is screwed down so as to provide for itself a clean electrical contact. A further object is to provide lateral spindles which are employed as spark gap gages

Railways and Their Accessories

AIR BRAKE TEST VALVE —C E ZACHARY 21 Latham St Atlanta Ga The invention relates to air brake test valves an object being to provide a device which can be located anywhere in the pipe line of a train, and which will serve to locate a leaky valve or break at any part of the line When the leak is found the air brake of the defective car is cut out and the brakes of the other cars operated until the defective car can be repaired.

INSULATED WHEEL STRUCTURE —I A CALL and J C CALL, c/o M O Bridges Dover N J One of the primary objects of the invention is to provide a wheel for use in connection with railway rolling stock and particularly adapted for use with electrical block systems which require the insulation of one portion of the wheel with respect to the other portion thereof A further object is to so construct the wheel that the tire will be rigid and at the same time be separated from the wheel body by a layer of insulating material.

CAR WHEEL BOXING AND OILING DEVICE.—A W MINNEY, c/o F Shepherd, Riverbank, Calif An object of the invention is to provide a simple structure of bearing for receiving the journaled ends of the axles with which the wheels are generally formed, and the connection therewith of an oiling device which causes a continuous circulation of the oil, and filters the oil each time it is used during the circulation thereby causing the train to run easier and resulting in a saving of expense in lubrication

DEVICE UTILIZING THE TREPIDATIONS OF VEHICLES —M A CANALE and R FRIAS Calle Maipu 671 Buenos Aires Argentina This invention relates to a device to be placed in railway cars street cars or similar vehicles and wherein the displacements or movements in any direction of the running vehicle are used to automatically move an advertising or displaying tape which is to be continually or intermittently moved or fed along

TRAP FOR REFRIGERATOR CARS —P S DOUGHERTY 7712 W 64th Place Chicago Ill Among the objects is to provide a trap which is of comparatively simple construction light weight and not likely to be broken when it is being placed in position the parts being made of a pressed metal such as pressed steel A further object is to provide a device which is relatively cheap to manufacture

Pertaining to Recreation

TOY —J POPPER, 1614 Ave M, Brooklyn N Y The object of the invention is to provide a construction which may readily be actuated by an operator and which will continue to operate after the operator has ceased his efforts A further object is to provide a toy which the operator blows into and by such action inflates a balloon and at the same time operates the eyes of a figure connected with the balloon

GAME SCORING DEVICE —A. R. HAGER Manila, Philippine Islands This invention relates to a special scoring device which comprises a plurality of relatively long counting pieces which are marked to divide them into several different classes, each class having a specified counting value and each piece having exposed thereon counting characters which are displayed by dots, the counting value of each piece being directly determined by the number and color of the dots.

FIGURE TOY —R NAKIAN, 315 Mountain Road W Hoboken N J The invention particularly relates to a toy broom including the idea of a female figure or other body in which the bristles are used to represent the skirt of the figure An object is to provide a device of this character either in the form of a toy broom or a full-sized whiskbroom, which will be attractive in appearance and comparatively inexpensive to manufacture.

MUSICAL TOY —W BARTHOLOMAE, c/o Bar Zinc Toy Mfg Co, 83 Greene St. New York N Y An object of this invention is to provide a toy which will not only produce a loud sound but will produce soft or loud musical sounds in the desired sequence according to the operator's actuation of certain parts of the device. A further object is to provide means which may be manipulated by the thumb or finger of the operator to change the tone of the sound

LAND AND WATER TOY —J L. DUGAN, 214 Elizabeth Ave., Elizabeth, N. J The invention relates to a toy boat in which an animated figure simulates an oarsman. The object is to provide a toy of this character in which the boat progresses seemingly by virtue of the action of the figure, which partakes of the body swing and movements of an oarsman operating a pair of oars.

TOY.—D. S. CLARKE, 314 W. 7th St., Muscatine, Iowa. An object of the invention is to provide a toy having animated figures, such as roosters, bulldogs, or the like, arranged to face one another and in which the figures may be caused to move to simulate action as in a fight. A further object is to provide a toy which is inexpensive to manufacture and not liable to break easily.

Pertaining to Vehicles

AUTOMOBILE HEADLIGHT.—W. D. OTT and H F GRIFFIN, Riverside, Iowa. Among the objects of the invention is to provide a unitary headlight which will divide the light energy emitted by the illuminant into three distinct spaces A further object is to provide a light which projects a relatively dim light in the space which normally includes the eyes of occupants of other cars, a brighter beam illuminating the ground at a distance in front of the car, and a third beam illuminating the ground directly in front of the car

CLUTCH HOLDER.—F F WUNDER, Valley Falls, Kan An object of the invention is to provide an attachment for a tractor whereby a clutch control lever may be releasably held in position to occasion the releasing of the driving connection between the engine of the tractor and the transmission thereof without disengaging the gears of the transmission The device may be applied to tractors of ordinary construction without any change of structure of the tractor

BRAKE FOR BABY CARRIAGE.—R. C STARRARD, 41 North 5th St., Paterson, N J The general object of the invention is the provision of a simple, inexpensive brake that is normally held in operative position on the back wheels when the carriage is not in operation, and capable of being moved out of operative position when a downward force is applied to the handle to move the carriage

AUTOMOBILE LOCK.—C A. HABENICHT 1242 Market St, San Francisco Cal This invention has for its object to provide a lock that works in combination with the switch controlling the ignition system of an automobile A further object is to provide a lock that will lock itself automatically every time the switch is turned off A further object is to provide a lock that may be taken apart so that the combination can be changed in case the key has been lost. (See Fig. 14)

HUB CAP ATTACHMENT — C F. REILLEY and J J LUDWIG, 117 East St., Woonsocket, R. I An important object is to provide a hub cap attachment for motor vehicles having a reflecting means which reflect the light rays from an approaching vehicle so that the operator of the approaching car is enabled to safely clear the vehicle equipped with the attachment. A further object is to provide an attachment which may be readily applied without altering the construction of a vehicle in any substantial respect. (See Fig. 15)

VEHICLE BRAKE.—H. A. PERKINS, Box 128, East Templeton, Mass. Among the objects of this invention is to provide a brake which may be applied to the tires of the rear wheels of a baby carriage or like wheeled vehicle, and which may be readily put on or off without mutilating the tips of the shoes, or requiring upward movement in such manner as to necessitate the scratching of the caps of the shoes. A further object is to provide a device which requires but a single operating lever which may be engaged by the sole of the shoe.

LICENSE PLATE.—D. McKnum and J. R. SELLERS, [illegible] L. A. Ry. Bldg., 1060 S. Broadway, Los Angeles, Calif. The particular object of the invention is to provide a license plate for motor vehicles which may be used permanently. A further object is to provide a plate in which [illegible]

may be detachably secured without impairing the neat appearance of the plate as a whole. A still further object is to provide depression in the original plate to which the smaller plates, having the year and the home-city of the owner, may be secured.

REVERSE-MOVEMENT CONTROL FOR DRIVING AND DRIVEN ELEMENTS.—C. P. Cirac, 854 Phelan Bldg., San Francisco, Calif. The invention relates more particularly to means for automatically preventing or controlling the reverse movement of driving or driven elements such as a power shaft or the like. The primary object is the incorporation of the device with the drive shaft of a motor vehicle, but it may be used in connection with various machine elements.

AUTOMOBILE HOOD.—J M. Woll, Kittanning, Pa. An object of this invention is to provide a hood construction which embodies a double top wall offering an air circulation space for protecting the paint and finish of the outer wall A further object is to provide means for protecting, sealing and cooling the front of the body immediately under the windshield, the construction is simple and inexpensive to manufacture.

AUXILIARY SEAT FOR AUTOMOBILES.—S. E. Gilley, 665 Oakland Place, Bronx, N Y The principal object of this invention is to provide means for increasing the seating capacity by the provision of an emergency seat which is adapted to be partially supported from and in front of the permanent seat, which in no way interferes with the regular seating capacity, and which includes means of adjustment to render the seat applicable to machines of various types and sizes.

TRACTOR.—F Hodgkiss, 722 18th St., Oakland, Calif. Among the objects of the invention is to provide a track-laying mechanism which reduces friction to a minimum, and which includes a sprocket wheel and track-laying links cooperating with the same. The construction is simple, and allows the track frame to ride directly on the hinges connecting the track links without any intervening wheels, or extra ball bearings, and rollers secured to the pins, allowing the track frame to ride with ease.

AUTOMOBILE PEDAL ATTACHMENT.—G. A. Milkie, 90 State St., Brooklyn, N. Y. The prime object of this invention is to provide a device readily attachable to practically all pedal and floor-board designs now on the market, whether the pedal be for a clutch, brake, or accelerator A further object is to provide not only a pedal attachment of simple construction, but an attachment which will close the slot in the floor-board in a fume-tight manner without interfering with the pedal action in any way.

CONTROLLER FOR MOTORS.—C. W. Plebaty, 4 Russell St., White Plains, N Y The invention has particular reference to manually operated controllers in the form of a starting box. The main object resides in the provision of means whereby the simple moving of the handle of the starting box in the usual direction will not make the proper connections, an especial movement of the handle of the starting box being required before the main line potential can be applied to the motor terminal.

AUTOMOBILE BUMPER.—E. W Kettlitz, Box 596, Valley Stream, N Y The invention aims for one of its objects to produce a bumper construction which contains a maximum of shock absorbing qualities without unnecessary weight. A further object contemplates a bumper construction with means for attaching the bumper to the chassis frame, and whereby the bumper may be readily applied or removed without the aid of a skilled mechanic.

AUTOMOBILE LICENSE BOX.—C. G Mercer, 167 W 66th St., New York, N Y An object of this invention is to provide a license box and illuminations therefor so that the device may be plainly seen by day or by night. Another object is to provide an arrangement whereby the numbers of the license will stand out very distinct, and with the parts of the box so arranged that access may be readily had at any time.

AUXILIARY SPRING OR SHOCK ABSORBER FOR VEHICLES, PARTICULARLY MOTOR VEHICLES.—T H. Rodda and B. N Rodda, c/o Collison & Co., Torrensville, South Australia, Australia. The invention relates to auxiliary springs comprising two curved members arranged in V form with their convex faces opposed, clamping plates enclosing the adjacent ends of the springs extending along the edge thereof, and means carried by the extended portions of the plates for engaging the springs at a point remote from the end to limit the opening movement of the spring members.

AUTOMOBILE SIGNAL DEVICE.—C Hermann, 780 Riley Place Binghamton, N Y Among the objects of the invention are to provide means whereby automobile signals can be quickly exhibited or produced at the will of the operator, the necessary mechanism being readily assembled on any type of car without altering the construction of the car The device is simple and could be manufactured at low cost.

TRANSMISSION LOCK.—H F Karlsle, Egg Harbor City, N J An object of the invention is to provide a lock which affords facilities whereby the propeller shaft of a vehicle may be held connected with the driving shaft of the engine of the vehicle and the driving shaft of the engine may be held against rotation, thereby precluding the operation of the engine and the propelling or towing of the vehicle until desired, and thus precluding theft or unauthorized use of the vehicle.

EXTENSION BODY FOR AUTOMOBILES.—L. Simon, 692 Broadway, Gary, Ind The invention is especially designed for the Ford roadster and may be readily attached to the car in place of the ordinary casing disposed in back of the seat. A further object is to provide a device which may be extended to carry twice the load which is ordinarily carried The body may be locked in extended position, and locked when close, whereby it is theft proof.

LIFTER BLOCK FOR MOTOR VEHICLES.—B F Christ Ida Grove, Iowa The object of this invention is to provide a device which is adapted to be placed ahead of a motor vehicle wheel to permit easy rotation of the wheel thereon for elevating the same. It is also an object that upon the wheel being disposed upon the block the means will automatically operate for holding the wheel against movement.

AUTOMOBILE TIRE.—J Gresszczuk, 21 Macon St., Brooklyn, N Y The primary object of the invention is to provide a resilient tire which includes a plurality of springs arranged in a manner to give the desired result without the use of pneumatic tires. A further object is to provide a tire having laterally and circumferentially spaced springs constructed in a manner to absorb the shocks occasioned by travel over a road way.

GAGE.—L. Foote, Pedro Miguel, Canal Zone, Panama. This invention relates particularly to water gages adapted to indicate whether or not the water in an automobile radiator has fallen below a predetermined level An object is to provide a gage which will enable the driver of a car to ascertain approximately the amount of water in the radiator without removing the radiator cap.

MOTOR VEHICLE ALARM.—P Down, 122 Concord St., Brooklyn, N Y The invention is primarily designed to signal the unauthorized removal of a car The general object is to provide a simple alarm device operated by the shaking of the car as it is moved away, or by the operation of the transmission mechanism when the latter is put into operation to remove the car

SLIDING-GEAR TRANSMISSION FOR FORD AUTOMOBILES.—F Paedersen, Bell Center Garage, Bell Center, Wis. This invention relates generally to transmission devices for Ford automobiles, the object being the provision of a device which is especially useful when the car is in muddy, sandy, and hilly countries, and will prove highly practical for tourists especially with trailers, or light delivery trucks.

TIRE HOLDER.—D. G Jeffries, Box 309, Tacoma, Wash The invention relates to means for holding a spare tire or tires on an automobile, and has for its general object to provide a device whereby the tire may be securely held, and locked against its unauthorized removal. The holder is constructed with consideration for the convenience of securing and removal of the tires.

TILTING STEERING WHEEL.—V W Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn Among the objects of this invention is to construct a steering wheel which is capable of swinging or tilting movement, in order that more easy access may be had to the driver's seat of a car, and to provide locking means for securing the wheel in operative connection with the steering post. A further object is to so construct the steering wheel that its mounting may be contracted in order to provide a rigid structure when the wheel is operatively connected.

CLUTCH CONTROLLING MECHANISM FOR AUTOMOBILES.—J A Ewell, Maplehurst Wash An object of this invention is to give the operator of an automobile an easier and more perfect control of his clutch A further object is to provide a control in which the usual foot pedal is operated in advance of a separate lever which directly actuates the clutch and which has a retarded and independent movement for throwing the clutch in at the time that the clutch takes a firm hold for connecting the power shaft with the drive shaft.

FOOT ACCELERATOR.—A M Alexander, R. 3, Box 47, Valley Mills, Texas. An important object is to provide a foot accelerator which may be conveniently applied to a motor vehicle without substantially altering the construction of the vehicle or marring the appearance of the same A further object is to provide means whereby the device may be employed for actuating the throttle arm of the carburetor without interfering with the hand operated throttle.

LUBRICATOR FOR INTERMEDIATE GEARING.—V W Page, Victor Page Motor Co., Melrose Ave., Stamford, Conn This invention relates to driving gears for accessory shafts of motor vehicle motors. Among the objects is to provide means for feeding a lubricant to the driving gears of the accessory shafts in such a manner that its action will be constant during the operation of the motor

OUTSIDE BRAKE BRACKET.—F J Andel, 3720 E. 52d St., Cleveland, Ohio An object of this invention is to provide a construction of bracket which can be conveniently attached to the brake disk of a car, which will function as a connecting means for the brake band and also as a guide for the rod connecting the ends of the brake band, and in addition will function to prevent lateral displacement of the brake band.

SELF-ADJUSTING HEADLIGHT.—W H Cornwell, 3561 Lincoln Ave., Oakland, Calif The invention has particular reference to the mounting of a headlight in such a manner that the latter will automatically assume a position in line with the direction of the vehicle, and the light vibrations will be reduced to a minimum. A further object is to provide a mounting means which will be adjustable to a number of different makes of vehicles.

SAFETY DEVICE FOR MOTOR VEHICLES.—A Rygiel and J Stern, 171 Avenue A, New York, N Y The general object of this invention is to provide a device for use in conjunction with motor vehicles to cause the application of the brakes to stop the vehicle when an object has been struck. This object is accomplished by mounting a bumper on means slidable, and associating with such slidable means lever releasing means which serve to cause the brakes to be applied. (See Fig 16.)

VEHICLE WHEEL.—E. J Krpata, Box 48, Higganum, Conn The general object of the invention is the provision of a device for use in connection with a vehicle wheel carrying a demountable rim to normally retain the demountable rim in position and which may be quickly and easily operated to release the rim when it is necessary to remove it from the wheel The object is accomplished by providing on the wheel a plurality of latches which may be operated by cam means to engage the demountable rim (See Fig 17.)

BURGLAR ALARM FOR AUTOMOBILES.—C H Summerill, 21 E. Maple Ave, Penns Grove, N J An object of the invention is the provision of an audible signal connected with the automobile engine through which a fluid under pressure is adapted to pass when the engine is operated by an unauthorised person, whereby the fluid will operate the signal and warn the police and public of the unauthorised operation. Means are included for maintaining the connection between the engine and the signal until the authorised operator unlocks the same (See Fig 18.)

TRANSMISSION GEARING UNIT.—P V Troupe, c/o Central Y M. C. A., Moline, Ill The object of the invention is to provide a compact unit supported in a housing which is flexibly suspended from the body of a vehicle. Another object resides in the provision of means whereby the thrusts and strains on the rotating gears are efficiently balanced to avoid lateral play A further object is to provide means whereby the gearing unit casing is so supported from a fixed point on the vehicle as to permit movement of the casing relative thereto.

TRACTION SHOE FOR WHEELS.—F P Girodo, 458 W 51st St., New York, N Y The invention relates to a simple attachment for the wheels of motor vehicles, and has for its object to provide a traction shoe designed for the purpose of extricating vehicles which have become mired or for assisting the same over bad stretches of road in which they are liable to become stuck. The device may be readily applied to or removed from the driving wheels of a vehicle.

VEHICLE FRAME SUSPENSION.—T Wilson, Indio, Calif An object is to provide a suspension frame which will bring the frame close to the rear axle and will not raise the body of the car higher from the axle than other forms of suspension. A further object is to provide a suspension frame which will permit a proper resilient action

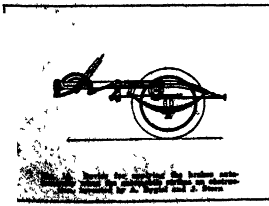


Fig. 16. Device for applying the brakes automatically when the automobile strikes an obstruction, invented by A. Rygiel and J. Stern

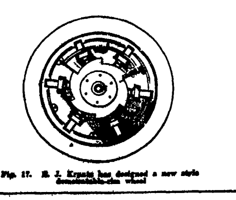


Fig. 17. E. J. Krpata has designed a new style demountable-rim wheel

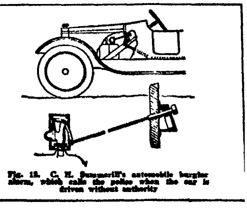


Fig. 18. C. H. Summerill's automobile burglar alarm, which calls the police when the car is driven without authority

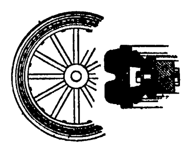


Fig 19. The latest novelty in automobile tires, the invention of C. Escher

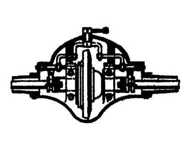


Fig 20. J. H. Dair's self-acting device for locking the differential when it is not in actual action

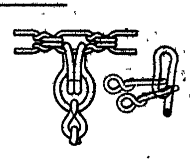


Fig. 21. Novel tire-chain assembly, developed by C. F. A. Nuebling, which makes the cross chains more secure while facilitating their removal

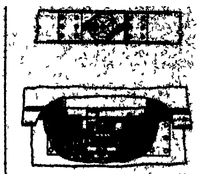


Fig. 22. O. D. Willis' newly patented door latch for automobiles

of the springs, and at the same time permit of positioning the body of the car at a minimum height from the axles.

TIRE.—C Escher, 740 Newark Ave., Jersey City, N J The invention relates to tires for mounting of vehicle wheels or demountable rims for vehicle wheels. The general object is to provide a durable and simply constructed tire. The object is accomplished by providing an inner rim, a cushion positively attached to said inner rim, an outer rim positively attached to said cushion and forming the cushion with walls flaring outward so as to provide bracing members adapted to support the rim against rocking (See Fig. 19)

SHOCK ABSORBER FOR MOTOR VEHICLES.—J O Delgado, Ave. Madero No. 20, Mexico, D F This invention has for its object to associate supplemental spring means with the ordinary leaf springs of a motor vehicle in such a manner that the supplemental springs will operate in union with the leaf springs in absorbing shocks, the supplemental springs being arranged to continuously take the load imposed upon the leaf springs and thus result in lessening the possibility of over burdening the same

LOW-PRESSURE ALARM FOR PNEUMATIC TIRES.—W. H. Brown, 610 S. Hudson Ave., Pasadena, Calif. Among the objects of the invention are to provide a device in which means are provided for utilising to a relatively great degree the air pressure within the device to move and hold the valves supported therein against or away from their seats. A further object is to provide means for mounting the device on a vehicle wheel in such manner as to preclude any appreciable effect on the action of the pressure fluid flow controlling means because of centrifugal action set up by the rotation of the wheel

FRICTIONLESS AIR BRAKE.—S. Giovannini, 214 N State St., Chicago, Ill An object of the invention is to provide a device for checking the speed of a vehicle or machine without subjecting any moving part to a friction that would tend to cause wear on the moving part. A further object is to provide a device in which the braking action is occasioned by passing a pressure fluid between two relatively moving parts. The device is simple and not likely to easily get out of order

TRACTOR.—F Hodgkiss, 722 18th St., Oakland, Calif. This invention relates to track laying tractors, the principal object is to provide a tractor compact, and powerful for its size, and in which clutch, transmission and differential are combined in a simple, compact working unit, allowing both sides of the tractor to be worked as separate independent parts.

DEMOUNTABLE RIM.—J G Reed, 235 Liberty St., Orwigsburg, Pa. The principal object of the invention is to provide a rim which will facilitate the removal and replacement of a tire, and which will be exceedingly simple and practical in construction and operation, strong, durable and efficient in use, and comparatively inexpensive to manufacture.

AUTOMOBILE LOCK.—J P Geraghty, 408 Grove St., Jersey City, N J The invention relates to locks for use on automobiles, auto trucks and other power driven vehicles or craft using gasoline as the motive agent. The object is to provide a lock designed to prevent feeding the gasoline to the carburetor and thus prevent an unauthorised person from running the vehicle.

SHOCK ABSORBER.—D. B D Blake, 400 Jersey St., Quincy, Ill. Among the objects of the invention is the provision of a shock absorber employing a flexible band connecting a portion of the chassis with the body of an automobile, and comprises the provision of means whereby the flexible band is always kept under a minimum tension to prevent the formation of slack portions. A further object is the provision of adjustable mechanism whereby the degree of application of the friction brake can be regulated as desired.

TIRE ARMOR.—L. C. Bonifacino and M B Irby, 5 Goodwin Road, Baltimore, Md The invention relates more particularly to protectors for pneumatic tires, the object being to provide a simple construction whereby sections of old outer casings or shoes may be coupled together in segments to form a tire protecting tread of such nature as to permit of ready substitution of different sections where it becomes necessary on account of wear

ATTACHMENT FOR DIFFERENTIAL GEARS.—J H Dair, Keyport, N J The invention contemplates an attachment for gears which is designed to render the differential unit inactive whereby the axle sections are locked together for simultaneous driving A further object is to provide means whereby when the attachment is not in use it will in no way interfere with the regular function of the differential. (See Fig. 20.)

LAMP SUPPORT.—V W Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn. One of the primary objects of this invention is to provide means for mounting headlights, which permits of the adjustment of the headlight. A further object is to provide a headlight mount in which the headlight may be bodily removed from the mount at will and the lamp supported in such manner that it is adjustable to the radiator shell

TIMER.—J E. Hiort, Whiting, Kan. An object of this invention is to provide a timer which may be used for engines, such as that on the Ford automobile, but which is provided with means for protecting the timer wires, so that there is no danger of causing a short circuit. A further object is to provide a timer having a rolling contact member, to facilitate the removal of dirt and grease, which will work off the contacts during the operation of the device.

OIL PUMP.—V W. Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn. The primary object of this invention is to so construct the lower half of the motor crank-case that the same will have as an integral part thereof the oil pump housing A further object is to so construct the pump housing that the rotor shaft and its driving gear may be supported between two well-oiled bearings thus eliminating the overhanging load on the pump bearing as commonly constructed.

PULLEY ATTACHMENT FOR TRACTORS.—H. C. Uttech, Lebanon, Wis. The purpose of the invention is the provision of a pulley attachment of that character which includes means for connecting or disconnecting the pulley from the transmission driving shaft of the tractor without removing any of the wheels of the tractor. The invention is particularly adapted, although not necessarily, to Fordson tractors.

FRONT WHEEL BRAKE.—V. W Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn. This invention pertains more particularly to a brake especially adapted for use in connection with front wheels. Its primary object is to provide mechanism by means of which the brakes of the front wheels may be applied regardless of the angular position of the wheels relative to the body of the vehicle or the line of travel thereof. The device is adapted to the conventional type of axle and front wheel mount.

AUTOMOBILE LICENSE PLATE CASING.—W A. Scott, Claremont, N. H., c/o General Delivery The invention has for its object the provision of means whereby a simple and economically manufactured casing is provided to support and illuminate the license plate as well as to serve as a tail light. Another object resides in the provision of means whereby a maximum and more uniform illumination of the plate may be achieved with an ordinary small light.

SPRING LUBRICATING DEVICE.—J M. Jackson, c/o Rope & Cordage Co., Union Trust Bldg., Parkersburg, W Va. The invention relates to devices for lubricating vehicle leaf-springs, and has for its object to provide a lubricant retaining material which may be easily wrapped or encircled about the entire spring or any portion thereof, so that dust or water may be prevented from retarding the resiliency, and the spring continue always well lubricated.

SIGNAL APPARATUS FOR MOTOR VEHICLES.—A. J Persson, Sparta, Wis. The object of the invention is to provide a signal apparatus which will present conspicuous signal arms both at the rear and forward end of the vehicle whereby to notify persons of the intention of the driver with relation to the movement of the vehicle and also the driver's intention to stop. The signal carried at the rear is adapted to be utilised as a tail light.

ANTISKID DEVICE.—C. F. A. Nuebling, Hewlett, L. I., N Y An object of the invention is to provide a construction in which accidental detachment of the cross chains from the side chains will be prevented. Another object is to provide a connection between the side and cross chains by means of which said chains may be readily detached from each other. The device is simple and inexpensive to manufacture. (See Fig. 21.)

TOP FOR VEHICLE BODIES.—C. P. Pond, c/o George L. Traffarn, Camden, N J The general object of the invention is to provide a top adapted to be mounted on a vehicle body to comprise a roof, together with panels hinged to fold for sustaining the roof in a raised position for making the vehicle body more available for living purposes, and to cause the roof to be lowered onto the vehicle for traveling or entering a garage.

COMBINATION TAIL LIGHT AND DIRECTION INDICATOR.—A. E. Tinker, 31 S. Aurora St., Stockton, Calif. The principal object of this invention is the construction of an indicator which may be remotely placed upon a car with respect to the driver, and which may be operated in an efficient manner without the necessity of the operator removing his hands from the steering wheel of the car The device is simple as to construction and wiring arrangements.

DIRECTION INDICATOR.—E. Buel, Kennedy, N. Y. Among the objects of the invention is to provide a device which may be mounted upon any type of automobile, and adapted to be easily handled by the driver of the car for indicating the course which he intends the automobile to proceed, the device being visible to anybody in the rear or forward of the automobile, either by day or by night.

SIGNAL SYSTEM FOR VEHICLES.—W. W. Kirby, 5419 Union Ave., Birmingham, Ala. An object is to provide a signal system which is operable to [illegible] present visible signals and give [illegible] the visible signals being [illegible] indicate the intentions of the driver [illegible] the movement of the vehicle. The system can be operated by the driver of the car, without in any way interfering with the operation of the vehicle in the usual manner, and may be applied to vehicles of various types with but slight change, if any.

ARMORED TIRE.—J. C. Mims, c/o E. H. Gros, 236 S. Hagan St., New Orleans, La. The object is to provide a tire which possesses relatively high cushioning properties while presenting a substantially puncture-proof construction which is of simple and durable construction and may be readily placed on or taken from the various types of rims.

DOOR LATCH.—O. D. Willis, 633 14th St., Huntington, W. Va. The principal object of the invention is to produce a latch for use in connection with motor cars, which will greatly facilitate the closing and opening of the door without in any way sacrificing the holding qualities of the latch when the door is swung to its closed position. A further object is to provide a sliding latch bolt, and a rotary keeper which functions in the capacity of a door check to eliminate slamming of the door. (See Fig. 22.)

TIRE.—J G. Johnson, Gordon, Pa. Among the objects of the invention is to provide a tire body or shoe having a tread construction adapted to prevent lateral skidding and circumferential slipping of the tire without any vacuum spaces being provided on the periphery of the tire. The tire is simple and inexpensive to manufacture.

Designs

DESIGN FOR A BOTTLE.—L. Bosokoff, 155 Norman Ave., Brooklyn, N. Y.

DESIGN FOR PIECE GOODS.—F. E. Silliere, c/o Garnet Print Works & Bleachery, 4180 Broadway, New York, N. Y.

DESIGN FOR A TEXTILE FABRIC.—C. E. Loan, c/o Galey & Lord, 25 Madison Ave., New York, N. Y.

DESIGN FOR DOLL.—G. F. McCann, c/o T E. Murray Co., 55 Duane St., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC.—P. Reimann, c/o M. Lowenstein & Sons, Inc., 40 W. 23rd St., New York, N. Y. The inventor has been granted patents on four ornamental designs for textile fabrics.

DESIGN FOR TEXTILE FABRIC.—R. Sonntag, Jr., c/o M. Lowenstein & Sons, Inc., 40 W. 23rd St., New York, N. Y. The inventor has been granted patents on two ornamental textile fabric designs.

DESIGN FOR A PLATE OR SIMILAR ARTICLE.—W. S. [illegible], c/o Pratt & McAlpin, 130 Broadway, New York, N. Y.

DESIGN FOR A VANITY CASE.—A. F. [illegible], c/o Evans Case Co., [illegible] Bldg., North Attleboro, Mass.

DESIGN FOR A TEXTILE FABRIC.—P. Reimann, c/o M. Lowenstein & Sons, 40 W. 23rd St., New York, N. Y.

DESIGN FOR A DOLL.—[illegible] McCowan, [illegible] W. [illegible] St., New York, N. Y.

DESIGN FOR A COMBINED ASH TRAY AND PIPE REST.—[illegible] 1654 S. Grand Ave., Los Angeles, Calif.

DESIGN FOR AN AUTOMOBILE SIGNAL-LIGHT CASING.—[illegible]

[illegible]

Good Driving Is Mostly
NICE STEERING

HOW TO PARK—HOW TO DRIVE—HOW TO ENJOY YOUR MOTOR CAR MORE

THIS ARTICLE** (Continued on next page) **SHOULD BE KEPT FOR REFERENCE

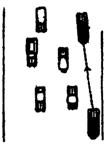
THE suggestions for the driving of motor cars and motor trucks presented here are not intended to be absolute or final It is understood that exigencies arise around which no rules can be laid, on the other hand the applications of the few simple principles outlined here, in ordinary driving, will better fit the driver to meet the emergency situations as they arise.

ATTENTION TO THE JOB IN HAND is first and most important. The good driver is never careless.

TREATING YOUR GUEST IN YOUR CAR AS YOU WOULD IN YOUR HOME is the first point of driving etiquette. It is not only discourteous, but illegal, to risk lives

In interpreting some of the instructions and suggestions the divergence of State Laws must be considered

City Driving

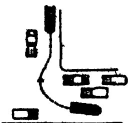


Avoid sharp turns, either to right or left

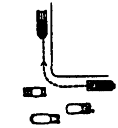
When moving out from curb do so in a gradual, diagonal line When swinging in to curb, do so slowly and gradually

Tell the driver behind as much as possible by the use of left arm signals

Do not depend upon his following your instructions Your signal does not give you the right to turn in front of him



Incorrect method of turning right

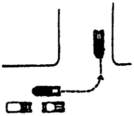


Correct method of turning right

When turning to right at street intersection get as close to right curb as possible before turning

When turning to left at street intersection get into extreme left lane of traffic.

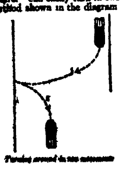
Incorrect method of turning left



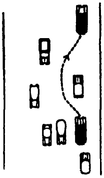
Correct method of turning left

When approaching a street intersection, the Nice-Steerer slows down to a speed from which he can stop quickly

In turning around in a street where there is much traffic three movements are necessary In streets where there is little or no traffic, the "Nice-Steerer" can easily turn in two movements by following the method shown in the diagram



Turning around in two movements



It is safest to turn out to pass immediately after a car has gone by in the other direction Then you are sure no one behind is passing you

The Nice-Steerer never cuts in quickly after passing another machine He realizes that the other car is *moving also*, and he allows ample time before gradually getting back to his place on the right of the road

The traffic lanes near the center of the street are for through traffic that is, cars that are not contemplating turning off to the right at the next several streets The right hand lanes are for slow or parking, or right turning traffic

The Nice-Steerer remembers that the rear wheels do not track the front wheels in turning He allows ample, but not too much, leeway for the rear wheels to miss curbs, posts, guards, traffic signals, building corners, etc

As a rule it will be found a time and trouble saver to turn about by driving around the block rather than jamming traffic by turning in the street (This is not allowed, anyway, in many communities)

MOTORISTS, motor clubs, truck operators, garages, automotive manufacturers and dealers, insurance companies, police chiefs, and other public officials, not only in the United States and Canada, but in Europe and elsewhere, have so far absorbed 1,784,392 copies of the booklet, "Good Driving Is Mostly Nice Steering" * 17,842 letters of commendation have been received And the method of distribution has been through receipt of actual requests

Nothing better indicates the deep and wide spread interest in good driving, which is mostly nicety of steering

It is plain how largely nice steering, so greatly in demand, depends upon ease of turning the front wheels

—Wherefore an ever increasing number of manufacturers use Timken Tapered Roller Bearings in the steering pivots

In steering pivots, as in transmissions, *and* on differentials, *and* on pinions, *and* on worms, *and* in rear wheels, *and* in front wheels, Timken dominance results from Timken extreme load capacity and ruggedness, and from Timken adjustability for the wear that *must* follow motion

*These pages are reprinted from the 12th edition of the copyrighted booklet, which will be sent on request made to the Timken Roller Bearing Co, Canton Ohio

TIMKEN
Tapered
ROLLER BEARINGS

Another opportunity for Nice-Steering presents itself minutely in avoiding bumps, ruts, track-crossings, etc The steering wheel should not be moved too quickly the reaction is difficult to compensate for, and it imperils all neighboring cars So long as both front wheels, or both rear wheels, do not hit the obstacle at the same time, the results are not bad

Street car tracks are at all times, but particularly in wet weather, dangerous to negotiate If the Nice-Steerer finds himself in the tracks, he flips his wheels first to one side, then quickly to the other, and thereby scrapes the tires as little as possible, while maintaining complete control of the vehicle.

Wet Streets

On wet streets the careful driver is even more careful

Skidding, once started, is hard to stop. Turning the wheels in the direction of the skid will help But this is dangerous inasmuch as usually there are cars, or children, or curbs, in the way.

THE ONLY SKID THAT YOU CAN CONTROL ABSOLUTELY IS THE ONE THAT DOESN'T START!

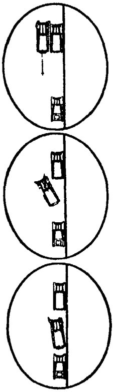
Slow, even turns slow, even stops, slow, even starts will avoid skids

Do not disengage your clutch!

Tire chains are of assistance on wet or muddy roads

Clear vision, obtained by windshield wipers, is also essential

Can You Park?



An easily learned method of proper parking in a limited space is to stop parallel to the curb alongside of the car behind which you are going to park, about one foot outside of it turn the front wheels sharply to the curb and

back slowly until you can see that by swinging the front wheels hard over to the left your right front fender will just clear the left rear fender of car ahead turn wheels fully to the left and

back to proper position at curb This method, once you know positions at which extreme turns are to be made will park you at the proper distance from curb and other cars in one backward movement

Country Driving

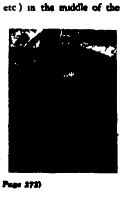
While the "Nice-Steerer" keeps constantly on the alert even while driving through little-trafficked roads, the first thing to be learned for comfortable touring or long-distance driving is a safe method of relaxation

Authorities agree that the safest and sanest grip on the wheel is one hand above the other, one palm up, the other down (See illustration) This grip provides the greatest leverage on the wheel with the least exertion And all of the necessary exponents of safe driving—hand brake, horn, throttle, etc, are within easy reach.

The intermittent use of the hand throttle, on good, open roads, will rest the right foot and leg The occasional use of the hand brake, besides being an excellent method of conserving both brakes, is also expedient and safe

At no time should both hands be free of the wheel Small stones, ruts, and bumps will quickly disturb the equilibrium and throw the car in the ditch

Do not stop (to repair tires, etc) in the middle of the road, near curves, or near the crests of hills



Stones should be removed from the road, after using them to block the wheels

Starting the Motor

The spark should be retarded.

The clutch should be disengaged so that the battery need not uselessly turn over the transmission gears.

It is often easier to start the motor by turning it over several times, with the air choked, before turning on the switch.

(Continued on Page 272)

GOOD DRIVING IS MOSTLY NICE STEERING—(Continued from Page 271)

Gasoline Line and Carburetor

Dirt in the gasoline line—and there will be dirt despite the most careful filling—should be forced out by air.

Dirt or water in the vacuum tank may be removed through the cap-screw at the bottom.

Dirt or water in the float chamber of the carburetor may be cleaned out by removing the screen container and blowing out both the container and screen.

The petcock at the bottom of the carburetor should be opened frequently to permit the accumulated water to run out.

Cooling System

Keep the radiator well filled. Use soft water, if you can get it.

The radiator should be completely drained and flushed at intervals of about once a month.

The fan belt should be tight to prevent slipping, but not too tight for easy running.

In the mounting of the fan, Timken Tapered Roller Bearings assure the same attention less service that they give in the more severe service points of the motor vehicle. For lubrication of fan see general lubrication chart in this article.

Steering Apparatus

The steering apparatus requires little attention, but should be inspected frequently to make sure that the front wheels are in line and that there is no play in either the wheels, the tie-rod, or remainder of the gearing

Tires should be kept properly inflated (See table of tire pressures in this article.)

And above all, the best assurance of easy steering is to own a machine, the steering pivots of which are mounted on Timken Tapered Roller Bearings In such machines the steering mechanisms—instead of scraping and grinding—turn easily on the rollers of Timken Bearings.

Battery

At least once in two weeks, and oftener in hot weather, the battery should be inspected to see that distilled water covers the plates in each cell by ½ inch.

If the hydrometer shows a reading of less than 1250, the battery should be recharged. A reading of 1280 means that the battery is fully charged.

Dry the top of the battery after filling. Keep terminals clean. An application of vaseline aids in preventing corrosion.

Spark Plugs

Clean, heavy-hitting spark plugs delight the "Nice-Steerer"

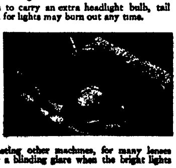
Plugs can best be cleaned by soaking in kerosene and scraping with a dull knife.

The points of the spark plug should be set apart about the thickness of a worn dime.

Lights

Both head and tail lights should be inspected before starting out.

It is a good plan to carry an extra headlight bulb, tail light bulb, and fuse, for lights may burn out any time.



To avoid danger to yourself, as well as other machines, your lights should be focused so that they do not throw their rays above four feet from the ground at any point.

The "Nice-Steerer" uses his dimmers when meeting other machines, for many lenses that are legal throw a blinding glare when the bright lights are on

Tire Pressure

The "Nice-Steerer" checks the air in his tires every week. Tires should carry:

Tire Diameter	*Pressure*
3½ inches	60 pounds
4 inches	70 pounds
4½ inches	80 pounds
5 inches	90 pounds

Cord tires may be run somewhat softer according to tire men, without excessive injury.

The spare tire should be protected from the weather.

Wheel alignment front and rear should be checked regularly

Inspect tires frequently and fill up holes and cuts with tire filler.

Tire Chains

If properly applied, chains are less harmful to the tire.

The hooks, when laying the chain over the top of the tire, should be toward the rear

The chains should be just tight enough to allow them to creep on the tires.

Insurance

Because not all drivers are "Nice-Steerers," and if you are contemplating buying automobile insurance, be sure you are covered before taking the car out of the garage. Not only may "tomorrow" be too late—it never arrives.

If You Have Never Driven a Car

This is the way to start your car after starting your motor:

(1) Disengage your clutch, put the gear-shift lever in low (first) speed position, and engage the clutch slowly as you depress the accelerator

(2) After the car has gained some momentum disengage the clutch, move the gear-shift lever from low (first) to intermediate (second) speed and engage the clutch gradually, as you slowly depress the accelerator

(3) When the momentum is between from 15 to 20 miles an hour disengage the clutch. Move the gear-shift lever from intermediate (second) speed into high (third) speed Engage the clutch (This does not apply to cars with planetary type transmissions.)

Maintenance of Timken Bearings

The greatest advantage of Timken Tapered Roller Bearings is the adjustable feature, or "take-up," as it is commonly called.

Many different methods are used in mounting Timken Tapered Roller Bearings in front and rear wheels, differential, pinion, and transmission of various types of vehicles. In any case the adjustment is easily made. All that is required is a half turn of a nut, removal of a shim, or the screwing up of a carrier that holds the cup. This moves the cone and roller assembly and cup closer together

Wheel Bearings. To take up the wear on wheel bearings is a simple matter. Draw up the nut on the end of the spindle until the wheel binds. Next revolve wheel to be sure all working surfaces are in contact. Then back off nut from one-third to one-half of a turn to a point where wheel is free running. At the same time see that there is no "play" when the wheel is shaken. Lock the adjusting nut at this point.

Do not mistake wear on steering pivot bolts or bushings for play in wheel bearings.

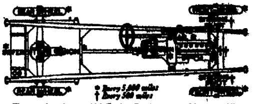
Nut or Screw Adjustment To take up the wear at rear axle and transmission, where screw or nut adjustment is provided, the nut or screw should be drawn up to a point where it starts to bind. It should then be backed off from one-third to one-half a turn and locked at that point.

Shim Adjustments. To take up wear where shim adjustments are provided, remove the bolts that hold the carrier in place. Take out one of the thinnest shims. This is usually all that is required. Next put bolts back in place.

Worm Shaft Adjustment The following instructions should be observed on adjustment of worm shaft bearings on 1, 1½, 2, 2½, 3, and 3½ ton trucks.

The worm shaft should be so adjusted as to make allowance for expansion from heat generated in service. On most trucks the adjustment is taken up on the front end of the worm housing by screwing on a sleeve which forces the cup farther over the cone and roller assembly. One notch on this sleeve equals about .005"

Adjustments should be made on various trucks as follows: On 1, 1½, 2, 2½ ton; screw the sleeve in until the end play is out of the worm shaft. Back off two to three notches which equals .010" to .015" end play. On 3 and 3½ ton trucks; screw the adjustment in until all end play is out of the worm shaft. Back off 4 to 5 notches, which equals .020" to .025" end play. The reason for this end play is, as noted above, to take care of expansion of worm shaft.



These are the points at which Timken Bearings are used in automobiles Each of these points should have attention (either inspection, lubrication, or adjustment) at the mileages indicated.

Lubrication of the Bearings Any light grease or heavy oil will serve as a lubricant for Timken Roller Bearings, if it is positively free from acid.

The lubricant should be placed in the grease cups, where they are provided.

In the case of wheel bearings, the lubricant should be spread with a paddle. It is advisable not only to spread it on the cage holding the rollers, but also fill the hub. This may appear like too much grease. Any apparent excess, however, will be taken up by the parts as soon as they are in operation.

The greatest care must be exercised to see that there is absolutely no grit on the paddle, in the grease, or on the bearings themselves.

Should the presence of grit be detected, wash the bearings thoroughly with gasoline and dry them, after which the lubricating should be done over again.

You will Know a "Nice-Steerer" by

His keeping to the right of the road, particularly on curves and over the crests of hills.

His extensive and intelligent use of arm signals.

His avoidance of all obstacles, however small, without endangering the occupants of his car or any other car.

His ease of handling.

His strict obedience of every traffic regulation.

His respect for "No Parking" signs.

His courteousness in hugging the right of the road when you blow your request to be let by.

His protection of his motor; his use of second and first speeds.

His alternate use of foot and hand brakes on long grades or in emergencies.

His never coasting (he always retains absolute control).

His thoughtfulness of pedestrians; he thinks for them.

His respect for railway crossings; he stops, looks, and shifts gears BEFORE he is actually on the tracks.

His realization that though the Manhattan Limited may be five minutes late, it still has "divine" right-of-way at the blind crossing.

His consideration of others by keeping his muffler closed in cities and towns.

His further consideration of others by ringing the door-bell instead of blowing his horn repeatedly.

His properly adjusted steering apparatus.

His slowing down at street intersections.

His use of the brakes BEFORE he gets to the curve.

His realization that, having seen the child, he (not the child) is responsible.

His "Nice-Steering".

These suggestions enlarged and amplified, have been incorporated in a readable booklet, "Good Driving Is Mostly Nice Steering" which will be sent upon request. The Timken Roller Bearing Co. Canton, Ohio.

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear in Electrical Notes, Service of the Chemist, Motor-Driven Commercial Vehicle, and other departments

Civil Engineering

The Disintegration of Mortar and Concrete in Sea Water is caused, primarily, by the attack on the free lime in the mortar by the sulfates in the water. This may be prevented by adding to Portland cement a silicious material which by combination with the free lime released in setting will form a cementing material insoluble in sulfate-bearing water. A comprehensive series of tests is to be conducted under the direction of the Committee on Marine Piling Investigations of the National Research Council.—*Engineering World*, 23 :1, pp. 25-31

Comparisons of Concrete With Clay-brick Masonry.—Exhaustive tests made at Columbia University show that while concrete brick units are individually weaker than claybrick units, when laid up in identical mortar and treated throughout in the same manner they produce as strong or even stronger masonry. This is due to the tenacity with which the concrete units and the mortar adhere. Tests were made on 185 piers in all. Considered from every structural point of view—load-bearing ability, stability and other considerations—concrete building units have been definitely proved the superior of clay units.—*Cement and Engineering News*, 35 :6, pp. 27-30.

The New Pullman Car Vogue in England.—Pullman parlor cars have long been used on a few of the British railways and have proved very popular. Now they are becoming still more so and a new service of all-Pullman car limited express trains has been put on between London and Newcastle. As shown by photographs in the Railway Gazette these trains are most handsome, both inside and outside, the latter being finished in umber and cream with gold decorations. Each train is made up of six Pullman cars, four Third Class and two First Class. The seating capacity is 33 to 39 passengers. The first class cars have a total length of 66 feet and a tare weight of 42 tons. They are equipped with dual brakes—Westinghouse and Vacuum, and are steam heated. On the initial run from Newcastle to London an average speed of 47.1 miles per hour, including stops, was made.—*Railway Gazette*, 38 :26, p. 949.

Why Our Pavements Have Failed.—Before spending $60,000,000 for new improved roads the State of Illinois made special tests on a $226,000 section of special road in order to learn what type of pavements were best able to withstand heavy truck and rural traffic. These tests were continued during the entire summer of 1922. Two outstanding and highly significant conclusions were the result. (1) The load-carrying capacity of any design of rigid pavement slab is in direct proportion to the ability of its weakest part to resist bending stresses. (2) Rigid pavements having a uniform thickness, or having edges thinner than the center will fail along the edges long before wheel loads are reached that would cause the destruction of other portions of the slab. From the first conclusion is derived the belief that the useful life of a rigid pavement being dependent upon the magnitude of the wheel loads that cause breaking stresses, we cannot hope to construct pavements that may be maintained economically, or that may not be utterly destroyed in a few months or years, unless wheel loads are rigidly controlled. Of the original 63 sections of the test road 50 were partially or completely destroyed and not one case of partial or complete destruction of a rigid section occurred that was not directly due to the lengthening and widening of one or more small broken corner areas. Absence of destruction along one edge of the road where the wheels traveled three feet from the edge is striking. Increasing the edge strength of pavements should, therefore, be of first importance in design. For existing pavements the loads should be limited. Designs for new pavements should provide for strengthened edges. The new design, based on these tests, therefore calls for a nine-inch edge thickness, tapering to six inches at two feet from the edge rather than tapering in the opposite direction. The edge is also to be strengthened by a continuous three-quarter-inch round bar.—*Highway Engineer and Contractor*, 8 :6, pp. 37-43.

Concrete Poles Produced by the Centrifugal Process are being brought on the European market. For use on a Swedish electric power transmission line 800 hollow concrete poles were built and erected in pairs, connected by reinforced hollow beams. The poles were 50 feet in length with a 10-inch top diameter and a 23-inch butt. Their average thickness is about two inches. Tests on a number of them showed that they were exceedingly elastic. It was proved that the tensile strength which centrifugal concrete will stand is considerably above the usual form for concrete. Some of the poles which were 64 feet long, when subjected to a bending stress of 7300 pounds bent 7 1/2 feet at the top without any signs of damage. The finished poles, made near Dresden, Germany, were shipped all the way to Sweden by rail and ferry and all arrived in good condition, having successfully withstood the vibrations and stresses due to transportation. These poles are made in a wooden mold consisting of two half-round forms lined with sheet iron. The reinforcement is made of rolled rods of open hearth material interwoven with three spirals of wire, one within the other. In order to give the maximum strength to the pole the reinforcement is kept close to the circumference. The cement mortar is mixed in the proportion of one to three, with the addition of some asbestos fiber. The mold is revolved at 500 to 1000 revolutions per minute. After revolving in the mold ten to fifteen minutes it is let set one or two days, then removed and kept in moist sand three or four weeks.—*Cement and Engineering News*, 35 :6, pp. 42-43.

Industrial Progress

Steam at Pressures Up to 1,200 Pounds will be used in the new power station of the Edison Electric Illuminating Company of Boston. The initial installation will include one boiler to work at this pressure. It will have about the same heating surface as the normal pressure boilers. The steam generated by it will pass through a pressure reducing turbine developing about 2000 kilowatts, and will be exhausted at 375 pounds pressure for reheating to 700 degrees and further use. If satisfactory results are obtained from the high pressure boiler-turbine units, more of them will be installed.—*Power Plant Engineering*, 27 :14, pp. 726-9.

A Robbery-proof Payroll Plan originated by a Detroit company consists in putting five dollars in cash in each envelope and giving a check for the balance. Where large balances are required for checking accounts the amounts due each employe are credited to a special account in the savings department so that an employe may draw the entire amount due him or draw only part, as suits his pleasure. This encourages the establishing of savings and checking accounts, leading to thrift and economy, and frequently to the household budget system.—*Factory*, 30 :6, p. 605.

The Czech Automotive Industry.—In a total population of 13,000,000 there are only two large automobile manufacturers and two small ones. There are 17,000 cars, including trucks. Little gasoline is produced in Czecho-Slovakia and its average cost is a dollar a gallon. The causes that check automotive growth are competition with Germany and Austria, difficulties of getting raw materials, and French competition in the Balkans, the chief field of Czech export trade. Yet trucks and tractors are being exported to Spain and Africa. There is a great basis

for expectation of a large growth of the industry due to the fundamental wealth of the Czech nation.—*American Machinist*, 59:12, pp. 59-62.

Balsa-wood for Refrigerators.—Much lighter than cork, and composed of thin-walled air cells, balsa is an ideal heat insulator. This wood is shipped from the tropics as a deckload on fruit steamers and is used in cold storage plants, refrigerator cars and in household refrigerators. In the latter case balsa wood forms the framework and insulation in one, a thickness of two inches of it being used throughout. The insulation is then lined inside and out with five-sixteenths of an inch of artificial stone having mangasite as a base.

Producer Gas is now being used for burning refractory brick. Continuous regenerative kilns are necessary for successful burning at high temperatures with this kind of gas. The compartment kiln, fired with producer gas, is best adapted for general refractories, having certain advantages over the car tunnel kiln. The use of gas has the advantage that a much larger quantity of fuel can be introduced and burned in the kiln, enabling it to be brought to the highest possible heat in all parts in the shortest possible time. In the continuous kiln, temperatures up to 1400 degrees Centigrade are is possible with recuperation.—*Jour Am. Ceramic Socy.*, 6-7, pp. 799-807

Pulverized Fuel.—During the past year, especially in the latter half, the use of pulverized fuel equipment for boiler plant operation has taken rapid strides and many new installations have resulted. Engineers of a large number of central power stations throughout the country are either experimenting with a trial installation or are seriously considering such an installation. Much progress has been made in the perfecting of existing installations and the development of the pulverizing equipment itself Although pulverized fuel has been in use for years in cement plants, iron and steel industries, ore reduction and chemical industries, the applications to large central power stations has caused a decided increase in the tonnage of fuel thus burned, the use beginning in 1895 and increasing uniformly to about 7,000,000 tons per year until about 1918, since when it has rapidly shot up to 30,000,000 tons per year —*Combustion*, 9 1, pp. 55.

Testing Flexible Boiler Staybolts Electrically.—No method of testing that depends upon the human element can be entirely satisfactory where danger to human life is concerned. The new method of inspection requires no change other than providing bolts with telltale holes extending from their inner ends into, but not through the bolt-head The testing is accomplished by making contact at the inner end of the hole with a small rod connected in series with a battery, a meter and a wire grounded on the boiler If the bolt were fractured, this condition would be shown up by the hydrostatic test that is made after all the bolts have been electrically tested. The telltale holes, being clean, will at once indicate a fracture by water leakage from the bolt that is unfit, as the holes extend all but through the bolt and therefore cover every breakable part of it.—*The Boiler Maker*, 23:6, p. 168.

A Great New Development in the Automobile Tire Industry is foreshadowed by recent experiments. A Hee car was equipped with 7½-inch truck tires inflated to only 18 pounds. It was found almost impossible to choose phraseology to drive home the wonderful effect that these large but slightly inflated tires have on the riding of the car. Road surface irregularities are toned down and in most cases are obliterated. One does not have to watch the road, nor be worried about being tossed up from the seat, nor pick out the good places in a rough road. The hope is to take advantage of the reliable cord construction, combine this with a large section and thinner wall and make it possible to ride on low pressure air for the protection of the car and comfort of the passengers. The goal is to employ such tire constructions that the tire durability may not be impaired and to increase the area of contact so that air pressures ranging from 20 to 25 pounds can be employed in actual practice.—*India Rubber World*, 68:4, pp. 622-4.

Increasing Boiler Production.—Surfaces at temperatures above the ignition point of gases have the power of increasing their rate of combustion, and with [illegible]

[illegible] Imperial College of Science and Technology, of England, has [illegible] a large proportion of the potential energy of gas [illegible] immediately into [illegible] in continuing the production of [illegible] bustion into a bed of granular refractory material. Great advantage was obtained from this latter process in the firing of tubular boilers. Steam production was greatly increased.—*Chemical Age*, 21:6, p. 254.

Pneumatic Sweeping of Industrial Dust.—Dust explodes in substantially the same way that gas does. It must be mixed with air and ignited. Each particle heats rapidly and to a high temperature, as envelope of air immediately surrounding it. The air expands and exerts force. Grain dusts are more inflammable than coal dusts. When a plant is destroyed by a dust explosion there are commonly two reports, a small, sharp one and a thundering, heavy one. The first one represents ignition of a small quantity of floating dust. The heavy one represents the far larger quantity of dust which has settled on many adjacent surfaces and has been shaken loose by the primary explosion. Thus a series of explosions may be propagated through a large area or group of structures and gather violence as more and more dust is disturbed. Following the explosion of an immense grain elevator in Chicago the sweeping of accumulated dust was resorted to and as process would simply raise more dust a system of specially designed vacuum sweepers was used. No dust may now gather on exposed surfaces and lie there as a potential menace—these surfaces are kept clean.—*Compressed Air Magazine*, 28-6, pp. 580-42.

The Chlorination of Swimming Pool Water is an extension of the principle underlying the chlorination of drinking water A liquid chlorine application has been installed in the men's swimming pool at the University of Wisconsin. The chlorine is added after the water of the pool is filtered and warmed. Plate counts were made on lactose agar 72 hours after plating and it was found that with 0.1 to 0.2 parts per million chlorine in the water there are days on which the count is reduced and bacillus coli eliminated. It was found that when chlorine was present in 0.2 parts per million bathers complained of smelling chlorine and of eye irritation. To maintain a pool in a potentially germicidal condition requires a chlorine residuum of free or of organic chlorine varying enormously in amount with the water used. There will be waters in which it will be impossible to maintain a sufficient residuum owing to the irritation to the eyes of the bathers. The chlorination of swimming pools is an intricate process depending on many factors which we do not yet well understand. Its status is that of a valuable adjunct to already proved methods of sanitation.—*Am. Jour. Public Health*, 13:6, pp. 478-80.

Why Rice Straw Paper Is Weak.—The use of rice straw is quite widespread in the Far East, but when used alone it makes poor paper In order to ascertain the cause of its weakness and find a remedy, tests were made at the University of Grenoble on some rice straw from Indo-China. The straw was cut, washed, and cleaned for one hour. Then it was cooked five hours with 12 per cent caustic soda at five degrees Baumé concentration. The material was then defibered and washed and bleached. The yield of bleached pulp was 30 per cent. Next the pulp thus obtained was beaten carefully, sized and loaded with starch. Considerable trouble on the machine was experienced owing to the weakness of the paper. The paper is, however, soft and agreeable to the touch and is of satisfactory whiteness. Rice straw pulp is [illegible]

[illegible]

Scientific American Digest

(*Continued from page 274*)

flated for a short time under heavy air pressure and brought to mold size before transfer to the vulcanising mold. In the layout of a tire factory producing tires by the flatband method the familiar tire cores, builder's stands and building machines are entirely eliminated, as are also air bags. In their places are substituted new types of machinery, such as the collapsible building drum, the inflating machine, and pressing or pre-forming mold. It is stated that band built tires are more conveniently and easily built, the process is at all stages readily controlled and inspected, and the building time is reduced one-half The flatband system of tire building is the latest advance in tire building methods, requiring lessened expense for factory equipment, and resulting in economy of production and full control of structural details.—*India Rubber World*, 68 4, pp 625 7

Predicting Next Year's Rainfall for Southern California.—Urged by the ever growing seriousness of the water scarcity, scientists have worked out a system of long-range rainfall forecasting that promises, with a fair degree of accuracy, to establish a basis for anticipating conditions a year ahead. Successful forecasts of the monsoon rainfall in India months in advance, based on observations of barometric pressure encouraged the investigations and a six year record of ocean temperatures for a ten weeks' period each year has been kept. So far these efforts have been quite successful. Some of the factors influencing the predictions are The deflecting force of the earth's rotation on winds, the influence of the ocean, the thermal effect due to the difference in radiation and evaporation from the land and water surfaces. The theory on which the predictions are based is that the lower the surface ocean temperature the greater the intensity of the ocean high pressure area and the greater the consequent seasonal coastal rainfall. The results of daily ocean surface observations agree with this inferred correlation between temperature and rainfall, a fall of one degree in temperature corresponding approximately to an increase of about two inches in the rainfall of the following year —*Engineering News-Record*, 91 1, p. 17.

Efficiency of Air Cleaners for Tractor Engines.—The majority of tests of this nature have been made by various manufacturers and in the field rather than in the laboratory where conditions such as varying wind velocity and direction, relative humidity of the air, and moisture content and other physical characteristics of the soil which effect its dustiness can be controlled. In these tests a standard dust was used. It was kept under identical conditions and fed to all of 26 makes of cleaners in the same manner and at the same rates. A 22 5 horsepower tractor engine was used in the tests. The air used was prefiltered before addition to the dust. Three runs were made with each cleaner, first at normal speed, then at light load, and lastly at service or variable load. The 26 makes included water types, dry types and oil types. The results indicate that the dust-separation efficiency of these 26 makes of cleaners on the market varies between 48 per cent and 99.8 per cent, although only eight of them ran below 90 per cent, five below 80 per cent and three below 70 per cent. The power loss caused by the addition of the cleaners in no case ran above 6 per cent, while in most cases it ran in the neighborhood of 1 per cent The 26 makes of cleaners are named in the article —*Agricultural Engineering*, 4 6-7, pp. 89-95, 109-16.

Quick-Setting Lime Plaster is the goal of efforts being made by researchers of the National Lime Association who have recently tried out 2000 mixtures, using 200 additional agents in varying amounts and combinations in an attempt to reduce the usual 20 hours required for lime plaster to set. It was found that cement clinker, calcium aluminate, or a combined addition of inorganic sulfate with carbon dioxide gives greatest promise. A plaster containing 25 per cent of cement requires 21 hours to set. The time was reduced to five minutes by the addition of magnesium sulfate and carbon dioxide in small proportions. In some cases the acceleration was so rapid that a retarder had to be used, gypsum and sugar in small quantities proving most satisfactory. A group of combinations was suggested as being the most likely to give good results in commercial developments. These are lime and calcined gypsum, lime and Portland cement; lime and calcium aluminate; lime and cement clinker, hydrated lime and ground quicklime, lime and an inorganic sulfate (with the possible addition of carbon dioxide), lime and dry silicate, lime and an inorganic carbonate, lime and a soluble aluminate, lime and cryolite, lime and a substance containing tannin —*Chem. and Met. Engineering*, 28:26, p. 118.

Ice Cream in Britain.—The ice cream habit has found lodgment in the British brain. One hears on all sides of the mushroom growth of many small ice cream companies in English pleasure resorts and population centers. England now consumes 400,000 gallons of ice cream per year, which is about one twelve-hundredth of the amount consumed in the United States, the American total running about 500,000,000 gallons.

Eliminating the Odors of the Meat Packing Industry is to be largely accomplished by a new and notable technical development known as the dry rendering of fats and described at length in *Chemical and Metallurgical Engineering*. Apart from its advantages in meat packing, this system of rendering, according to the editors of that publication, promises to revolutionise the detached rendering plant, the small soap factory and the municipal garbage plant. Moreover, the cost is reduced to about 30 per cent of what it was. This is accomplished by the fat percolator in combination with the improved melter and an expeller The hashed fat is put into a rotary melter and subjected to 60 pounds steam pressure. Next, the fats reach the percolator, a shallow, cone-bottomed tank, and percolate through to storage, the solids staying in the percolator and following along to an expeller from which the residue or "cracklings" are discharged in cake form. The lard produced by this process is dry and sweet. It takes only from six to seven hours to bring the raw material from the killing floor to finished product All products entering the melter are fresh and sweet, and remain so sweet and fresh that no special equipment is necessary to avoid bad odors. There is no chance for decomposition The morale of the employes is improved, for the process is clean and dry It is believed that this is the most important step made by the meat packing industry in its history.—*Chem. and Met. Engineering*, 29 3, pp. 93-96.

Monolithic Linings are proving a success in blast furnaces where brick linings have been a continual source of annoyance The almost entire elimination of joints is probably the most radical step toward longer furnace life that has taken place in a long time. The lining is a one-piece lining of a single material that, after the first heat, assures a smooth, tough surface. There are no protruding parts to be exposed to the heat, to form the nucleus for the building up of clinker masses or to melt down and cause trouble and expense. There are no joints to cause weakness, to serve as channels for cold air to enter the furnace, no bricks to loosen and fall out, no cement to fuse and disappear and no unequal expansion and contraction. Finally, there is no chemical action between different substances.—*Forging and Heat Treating*, 9:6, pp. 260-2.

Plaster from Limestone Dust—A New Process.—The possibility is that a new process has been discovered by Mr Cyrus Field Willard of San Diego whereby an application of colloidal chemistry may solve the problem of making plaster directly from limestone dust and thereby materially reduce the cost of building. Studying the accepted belief of geologists as to the origin of the earth's vast deposits of limestone, the question arose, "What were the collifying influences that brought about the formation of fine sediment of calcium carbonate into stone?" Is it not possible, by finely comminuting this limestone and then adding different organic and inorganic substances finely comminuted and mixing them together in water as limestone was formed, to form a paste which will make a hard, firm, solid, homogeneous substance when the water has dried off? The attempt succeeded and thereby was discovered a new process which does away with the necessity of burning in expensive lime kilns the calcium carbonate and calcium oxide and, by hydration, forming hydrated lime which when mixed with water, sand, etc., and applied as plaster on the walls, gives up its water and absorbs carbon dioxide from the atmosphere to restore the lime to its original state as calcium carbonate. "Why," says Mr. Willard, "go through all this cycle when it is not necessary?" The new lime is over 96 per cent limestone with a collifying material so cheap

that it will not exceed a fraction of the cost of lime The exact nature of the col lifying material is, however, not being announced at present until some patent uncertainties are cleared away —*Rock Products*, 26 13, pp. 30-42.

A New Bleaching Process has been developed which, it is claimed, in less than half the time usually consumed in bleaching without the use of lime or strong acids, will eliminate all specks, motes, shives, etc , from raw cotton, cotton yarns, and cotton piece-goods, and will give the goods a lasting soft white finish that will not turn yellow with age It is a clean, sanitary process, easy to use, requires no change in equipment, and effects a great saving in cost. The process consists of dissolving the bleaching powder in cold water putting this solution into the vat filled with boiling water, and then putting in the goods, which are brought to the white in about three hours. The bleaching liquor is then drained off, the vat refilled with hot water, and the goods soaped off and dried in the regular way The powder, mixed with cold water, releases a gas when put in boiling water that permeates the textile material and destroys impurities.—*Color Trade Jour*, 13 1, p 32

Mechanical Engineering

Metal Polishing Investigated — Research carried on by Sheffield University on metal polishing indicates that the three sharpest abrasives are silicon carbide artificial corundum and emery Of these the most durable was artificial corundum, then came emery But sand broke down at a very rapid rate and the surface became smooth very quickly There are indications that in polishing the actual atoms of the metal are dealt with and they become so mobile that they are actually in a fluid state —*Abrasive Industry*, 4 7, pp 201 2.

Temporary Ductility of Sheets of Silicon Steel may be obtained to a small degree by heating them slightly before the work is performed Silicon imparts hardness and brittleness to iron making iron silicon alloys of more than 8 per cent content unusable except where castings can be employed When the silicon content exceeds more than 4 2 per cent the sheet is too brittle for punching and shaping, and if sheared it often breaks along a haphazard path in advance of the cutting tool Temporary ductility may be obtained by carrying on cutting or deformational operations at temperatures slightly above atmospheric, the temperatures depending on the steel composition Brittleness, however, is modified only slightly by heat treatement. The effect of several alloying elements is silicon raises the critical ductility temperature aluminum likewise raises it while manganese lowers it.—*Iron Trade Rev*, 73 2, pp 107 10

A New Method of Inspecting Steel by its magnetic qualities is outlined in the *American Machinist* By a combination of two independent magnetic circuits tests were made on the hardness of cold rolled steel The test is non destructive and it is possible to evaluate the internal changes concomitant with structural changes. The method is believed to be wholly new and it has found successful commercial application during the past two years. It has enabled the manufacture of a better and more uniform product with practically no change in equipment. It permits a rapid test with portable apparatus and commercial alternating current. A single measurement can often be made to read the desired combination of such qualities as strength, hardness and brittleness.—*Am Machinist*, 59 .3, p. 146.

Machine Shop Developments of the Present Year include some very definite tendencies. There has been a noticeable increase in the use of special machinery, with the tendency away from the single-purpose machine. There has been an increased use of the single-pulley drive, the individual motor drive, and transmissions of the automotive type. The automatic feature has been developed rapidly There has been an increase in the development of safety devices, in the use of brakes to stop revolving spindles quickly, in the use of roller and ball bearings, in the adoption of hydraulic feeds and hydraulic drives and in the use of rapid traverse. Foolproof construction has been highly developed. Grinding machinery has developed rapidly Another important tendency is the growing use of the centerless grinding method. There has been increased use of the open-side planer, a leaning toward the crank press for hot pressing and hot forging, the development of washing ma-

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Electrical Notes

Asbestos-Insulated Fixture Wire, available in various colors to match the finish of fixtures, has been developed to meet the need for a fixture wire which would not only harmonize with the fixture in instances where the wire is exposed, but would have no braid to char when used in close contact with lamps operating at high temperature. The superiority of asbestos insulation on wires subjected to heat is well established. The insulation of the present asbestos-covered wire contains no rubber or other combustible material. It is insulated with fibrous asbestos, impregnated to resist moisture and applied to the wire in such a manner as to leave no openings such as are sometimes found in braided yarn coverings. The wire is obtainable in six different colors to match standard fixture finishes.

Bureau of Standards Tests on Electric Lamps.—More than 1,660,000 lamps purchased by the United States Government were inspected by the Bureau of Standards during the fiscal year ending June 30, 1923, according to a statement in *Electrical World*. Samples of these lamps were tested for candlepower and were then subjected to the life test which consists in burning the lamps continuously until they burn out. In order to reduce the time required for this test the lamps are burned at a higher voltage than their rated voltage, the relation between their life at this voltage and their life at normal voltage being known. A total of 1608 samples were thus tested, these consisting of 1318 vacuum tungsten lamps, 216 gas filled tungsten lamps, and 74 carbon lamps. During this time the Bureau also tested about 850 samples, representing a number of brands which were submitted to the States of New York and Illinois in competition for State contracts.

Flash Rod Arresters.—Simple in construction, very sensitive and efficient in operation, the flash rod type of lightning arrester is becoming more and more popular for high voltage transmission lines. Furthermore, because of the various features of this type, it can be depended upon to provide greater protection from failures and trouble than most forms of arresters in service. The flash rod arrester consists of a flash rod with horns mounted at each end, and a discharge gap to ground with a limiting resistance in the ground circuit. While the flash rod materially increases the sensitiveness, its principal function is to provide a means for quickly breaking the power arc which in a small percentage of cases only follows a discharge. When a power arc does follow to ground, the arc across the flash rod is instantly transferred to the horns and almost instantly extinguished. The flash rod does not heat appreciably during discharges, and shows no depreciation after considerable service. The makers of this type of lightning arrester claim that they have seen one of these arresters discharge about twenty times in forty minutes—a dozen of these discharges occurring within fifteen seconds. The resistance was in no way damaged.

Corona-Proof Wire.—Ordinary rubber insulation deteriorates rapidly when the wire carries high voltage current unless it is covered with a lead sheath, according to *Electrical World*. This is because conductors raised to a sufficiently high potential are surrounded by an electrical discharge—luminous in the dark if the voltage is high enough—called corona, which takes place whether the conductor is insulated or not. Corona generates ozone from the oxygen in the air, and ozone very rapidly oxidizes rubber insulation, causing it to crack open, especially on the outside of bends. Although corona discharge takes place at quite low voltages, it does not attain harmful intensity under about 2000 volts and usually remains invisible up to much higher voltages. If the rubber-insulated conductor is covered with a lead sheath, either the ozone generated by the corona is kept from contact with the rubber or does not occur at all, if the sheath is grounded, so that these cables may be used for transmission voltages. There are some classes of service, however, for which it is desirable to use rubber-insulated, non-leaded conductors for currents at which corona is formed. To this end certain manufacturers of electric cable have introduced a corona-proof wire which is covered with a special saturated braid. This wire has been subjected to the most searching tests, which have shown conclusively that it is proof against the destructive effects of corona.

Electrical Notes

Simplifying Bell Systems.—From England comes a good suggestion in the way of a self-contained bell outfit for use in the home and shop and factory. Ordinarily, it is pointed out, the electrician installing an electric bell uses considerable ingenuity in hiding the battery, so it seems, with the result that at some future date one may be quite troubled seeking the battery which requires renewal Several English manufacturers have introduced bells and battery boxes in one unit, with terminals which are merely connected to the wires of the bell ringing system In this manner the battery is always at hand and convenient for inspection and renewal, which will doubtless prolong the effective life of the battery and make replacement cheaper

Mechanical Rectifiers.—From a recent issue of *Elektrotechnische Zeitschrift* we learn that synchronously vibrating mechanical rectifiers are capable of delivering singly or with two vibrators in parallel up to 1½ kilowatts of direct-current energy, which is sufficient to feed projection arc lamps or charge large storage batteries. Tungsten contacts careful tuning of the vibrator and condensers across the contacts insure a sparkless operation It is claimed that these rectifiers are much cheaper than motor-generators, and have at the same time a considerably higher efficiency For an output of up to six kilowatts, the German author suggests the use of rotating commutators, driven by and mounted upon the shaft of a fractional horsepower motor, self-starting synchronous type. Such a rectifier for a capacity of 5000 watts direct current operates with an efficiency of more than 75 per cent

Automatic Telephone System in South Africa keeps pace with the spreading use of the automatic telephone system throughout the world Automatic telephone exchanges are shortly to be installed at Port Elizabeth and Pietermaritzburg It is intended to extend the automatic system throughout South Africa as the existing plants require replacement The post office authorities have been wide-awake in the matter of up-to-date telephone installations but have been handicapped to a considerable extent by financial considerations and the holding up of all development during the years immediately following the war The automatic system offers the outstanding advantage of enabling an all-night service to be given in places which cannot obtain such service with the manual exchange It is generally assumed also that it will be much less expensive to maintain than the present system.

An Electrolysis Investigation has been undertaken by the Bureau of Standards in the city of Galveston This investigation is cooperative in character, all of the utilities in Galveston which were concerned in the electrolysis problem having arranged to participate in it and cooperate actively with the Bureau in making the tests. The primary object of the work is to secure additional data concerning the application of the earth current meter to electrolysis testing. It is expected that the results will demonstrate further the utility and necessity of employing this method and instrument where reliable information as to electrolysis conditions and a quantitative measure of the degree of hazard are required The investigation is, therefore mainly one of fundamental research although it is expected that considerable detailed information regarding the local electrolysis conditions will be obtained, and a study of the effectiveness of mitigative measures will be made

Small Ear Telephone.—From the *Electrical World* we learn that a radically new telephone construction has been put on the market by a German concern, primarily for the use of persons who are hard of hearing. The customary standard receiver, which is held to the ear by a steel strap, not only causes painful pressure upon the head but attracts unnecessary attention to the impediment of the bearer This new telephone might be called rightfully the smallest ever built. It measures only about an inch in length, and its open end is to be inserted into the ear, being held there by proper shaping of the end piece. Being of such small dimensions, it was not possible to use an iron diaphragm for the sound generator. A fine piece of specially treated skin with a tiny piece of iron fastened to its middle serves as a membrane. The voice reproduction is claimed to be excellent, and it is ad-

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chines for metal parts, and a notable increase in the number of tools for automotive repair work.—*Am. Machinist*, 59 .3, p. 83.

The Increasing Use of Pressed Steel is due to the rapidity with which pressed steel parts can be made, and their relative cheapness when produced in quantities. At present a large, new field for the use of pressed steel parts is being developed In many instances it has been found advantageous to replace gray iron castings with pressed steel parts. Covers, frames, boxes and other metal parts that can be made conveniently from pressed steel are lighter, stronger and cheaper An iron casting must be reasonably thick to permit molding and afford sufficient strength The pressed steel part can be made much thinner, and yet is stronger because of the great strength of steel It does not have the brittleness of cast iron, and can stand a remarkable amount of abuse without damage Being thinner, the steel part is also lighter, an important consideration with present high freight rates, when the manufactured articles have to be shipped long distances The only serious factor in this process is the cost of the dies. Sometimes, parts that cannot be made in one piece by the power press method can be produced in two pieces and welded together at a considerable saving over a casting—*Machinery*, 29 11, p 860

Melting Malleable Iron with Oil—The extreme simplicity of converting a coal fired foundry melting furnace for the use of fuel oil, its ease of handling and its lower melting cost have caused malleable foundrymen to consider the use of oil Experiments began in 1921, and for more than six months four furnaces have been operated successfully with oil One furnace has been in constant operation since June, 1921 The only changes necessary are the filling in on top of the grates with ashes or cinders, the construction of a combustion chamber and the introduction of the burner which atomizes the oil thoroughly either by steam or air Some poking and skimming is necessary, although this work is light when compared with that of the coal fireman Fuel oil adds little if any sulfur to the iron The carbon losses are high when using oil and it is necessary to charge the extra carbon Phosphorus is neither lost nor gained The average oil consumption is approximately 65 gallons per ton A comparison with coal for one day's operation of a furnace melting two 10-ton heats shows a total cost of $92 60 when using coal and $76 when using oil. The life of sidewalls is about 40 per cent longer when oil is used—*Iron Trade Rev.*, 73 1, pp 83-4

Practical Heat Treatment of Duralumin—Duralumin is annealed between the temperatures of 350 degrees Centigrade and 380 degrees Centigrade and cooled air, whereupon it becomes so plastic that it can be readily worked and formed into all sorts of shapes and sections. After annealing the duralumin is tempered by immersion in a salt bath heated to 480 degrees Centigrade or 500 degrees Centigrade and quenching in boiling water The salts employed are potassium nitrate and sodium nitrate, in equal parts. The object of the quenching bath is to remove the heat from the metal at a rate best suited for the qualities desired and the bath has no virtues other than removing the heat. Recent investigation has demonstrated that air-cooling is slightly better for annealing. Tempering duralumin differs from tempering steel in that while steel hardens at once, duralumin becomes soft at first, then hardens gradually and reaches maximum hardness in about 100 hours. Duralumin heated to 370 degrees Centigrade and quenched remains soft and workable for approximately 24 hours. If heated to 510 degrees Centigrade and quenched it also remains soft for the same length of time. But after heat treatment at 510 degrees Centigrade the hardness and ductility increase. The best properties are obtained at 510 degrees Centigrade. But it must not exceed 520 degrees Centigrade, else the metal will "burn." Quenching has usually been done in cold water If exposed to salt spray duralumin quickly coats with oxides which, however, are a protecting coating—*Mechanical World*, 73 1902-3, pp. 377-8, 395-6.

Improved Methods of Melting Iron adopted by a British rail-chair foundry have increased the output 12 per cent and reduced labor costs $1800 a year The new installation consists of two cupolas 56 inches in diameter inside of lining, with a melting capacity of nine tons per hour. They are charged mechanically by means of a skip bucket apparatus operating on a monorail trolley system, two balanced elevators being used to hoist the skips to the charging floor level Each skip or charging bucket is suspended from an automatic scale which constantly indicates the load being carried As the buckets are filled in the yard it is only necessary for the workman to load in enough charge to bring the scale pointer to a predetermined figure. It is just as easy, therefore, to load on the correct weight as some other amount, as workmen are wont to do, continually The best way to do the job is also the easiest way, assuming uniform charging A second feature is the correct distribution of the charges in the cupola by reason of their being dumped alternately into hoppers on opposite sides of the stack.—*The Foundry*, 51 12, pp. 475-8.

The Oxy-Acetylene Method of Cutting Metals is finding an increasing number of applications in the production of machinery and machine tools Probably the greatest savings in the machinery field accomplished with this process are made through the elimination of special forgings and castings and the substitution of parts cut from stock sizes of machinery steel, steelplate, bars, billets, angles, channels and other readily obtainable materials. The use of steel plate or steel slabs rather than special castings or forgings often makes possible the production of lighter, stronger machines. The cost is generally less than when special castings must be made, and in all cases the employment of stock material, by eliminating the delay incident to the production of special parts, cuts to a minimum the time necessary for special production. Lately the practice has been finding favor, where important forgings are being cut to shape with the oxy acetylene blowpipe, of preceding the cutting by preheating the forging to a dull red if the depth of the cut is more than five or six inches. Particularly in heavy sections of material of high carbon content this preheating will tend to eliminate strains and prevent checking—*Machinery*, 29 11, pp. 857-9

Metallurgy

A New Stainless Alloy has been developed by Sheffield manufacturers which, it is claimed more than matches stainless steel in utility Spoons and forks have been found really stainless in domestic use. Vinegar, lemon juice, sauces, vegetables and salad dressings appear to have no action whatever The alloy tests Tensile strength, 42 tons per square inch yield, 25 tons per square inch, elongation, 38 per cent on two inches, Brinnell No 156.—*The Metal Industry*, 22 25, p. 638

Extra Light Alloys are those whose specific gravity is under 2, for example, alloys of magnesium with aluminum, zinc, cadmium and copper which are the four most often used Their modulus of elasticity is relatively smaller than their increase in tensile strength, elasticity and elongation. Thus, in order to obtain an increase of 10 per cent in the modulus of elasticity, an addition of 4 per cent to 5 per cent of zinc or aluminum, and of 8 per cent to 10 per cent of copper is required. These very light alloys have a maximum tensile strength of 18 tons per square inch Magnesium is very corrosible and its alloys are still more so. It is inflammable and is not recommended for use in internal combustion motor parts subject to high temperature. The resistance of these alloys to alternating stresses of pressure and tension is not comparable with that of steel and their modulus of elasticity is poor Magnesium alloys may be cast in air, although casting in vacuum is better whenever practicable.—*Engineering*, 115 .3000, p. 796.

Influence of the Base Metal on the Structure of Electrodeposits.—Experiments were made in which copper was deposited on strips of copper having definite structures. The results, as shown by photographs, show clearly that under certain conditions the microstructure of electrolytic copper is a direct continuation of the structure of the base copper That the electrolytic deposits have not simply the external form but also the internal structure of the copper on which they are deposited may be seen from photographs of the etching figures of the crystals of the electrodeposit. These have the same orientation as those in the cast copper upon which they were deposited. It is therefore entirely reasonable to expect that under certain conditions the structure of an electrodeposit of one metal may be

influenced by that of another on which it is deposited. Most of the metals have similar space lattices, and in alloys such as brass produced by fusion, within certain ranges atoms of zinc can replace those of copper without changing the atomic spacing. Crystal growth is especially probable between nickel and copper, or silver and gold, both pairs of which have almost identical atomic spacings.—*Brass World*, 19-6, pp 180-2.

A Newly Developed Cell for the Rapid Deposition of 999 Silver from anodes containing high percentages of base has been developed by A. H. W. Cleave, Deputy Master of the Royal Mint at Ottawa. The new cells are circular, 36 inches in diameter and the cathodes rotate at a peripheral speed of 40 feet per minute The current density runs from 75 to 150 amperes per square foot. The electrolyte is contained in the annular space between the outer and inner walls of the cells. The cathode carrier revolves on a light ball bearing Owing to the specially designed cathode, and special grouping of the anodes the current becomes a pulsating one The cathodes are automatically stripped by means of a scraper, thus keeping the resistance of the cell constant. The deposited silver is dense and crystalline and is invariably as high as 999 fine and at times reaches 999.9 One great advantage is the great reduction in the amount of precious metals locked up in the process and the reduction in the time they are locked up, effecting a saving in interest charges The amount of fine silver produced per cell per hour has been more than doubled.

A Rapid Test of the Durability of Glass is furnished by the reagent narcotine hydrochloride A dilute solution of the reagent is made, consisting of one part by weight in 1000 parts of distilled water It must be made up in a very resistant glass. The receptacle is placed in a water bath, heated to boiling water temperature and kept thus some time The vessels to be tested are washed with distilled water, acetic acid and alcohol successively, are dried and brought to 100 degrees Centigrade in a water bath The reagent is poured into the vessel about to be tested, the heating is continued and the solution is observed at intervals of 10, 20, 30, 45 and 60 minutes. If a cloudy deposit appears within ten minutes the glass should be rejected as poor glass. If it appears at 15 or 20 minutes but does not increase during an hour, the glass is better but still not good enough to be used for medicines in which alkaloids are used —*The Glass Industry*, 4 6, pp. 108-9

A Small Percentage of Copper Added to Steel prevents the rapid deterioration that otherwise takes place under the influence of the weather and of the acids from factory smoke Recent observations have proved that steel freight cars built in recent years have been deteriorating very rapidly, due to corrosion But some boxcars with iron bodies built in 1862 by the Baltimore and Ohio are still in existence and the original iron sheets of the bodies are well preserved, notwithstanding they did not receive the usual protection of frequent painting A piece of this plate was analyzed and found to contain a very low carbon content, 02 per cent of sulfur, 084 per cent of phosphorous and .54 per cent of copper Low carbon steel now commonly used for car work is about as follows Carbon, 18 per cent, sulfur, 045 per cent, phosphorous, 015 per cent to 035 per cent, manganese, .50 per cent, copper, none As tests, a piece of copper steel and a piece of ordinary steel plate were immersed in a saturated solution of sulfate of iron scraped from the sides of a weathered car of bituminous coal. The result showed that the copperless steel was dissolved at about 25 times the rate of the copper steel Copper steel is therefore now being used in the repair of steel cars, many of which must be rebuilt after only 10 or 12 years of service.—*Railway Age*, 74:28, pp. 1427-30.

Mining

The Quantity of Petroleum Produced by the United States, as a percentage of the world's total, is now about 60 per cent. Mexico produces about 25 per cent. In 1922 Oklahoma, California and Texas each produced roughly one-third of the United States production

A New Apparatus for the Coking Test of Coal has been devised for the purpose of showing more markedly the difference in the coke produced from various coals, and allowing the process of carbonization to be

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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Radio in Mine Rescue Work.—In the near future radio telephony will probably play an important part in the work of colliery rescue parties. As the rescuers carry out their duties, constant communication will be kept up with those directing operations from a base. That is the object underlying a series of experiments being conducted at Ashington Colliery in England A considerable measure of success has already attended their efforts, and quite recently speech and music were successfully received underground. A party equipped with a three-tube receiving set descended the shaft of the Carl Pit, and fixed a 20-foot aerial on the baulks supporting the roof. Only one head 'phone was used, but so clear was the reception that the five men composing the party all heard distinctly Experiments have already been carried out to depths of 800 yards, and it is expected to test reception at depths of 1000 yards.

Submarine Cable Replaces Radio Link. The only commercial radio telephone link in the world, which for the past three years has been handling telephone business between Catalina Island, 30 miles off the coast of California, and the wire lines of the Bell system, has been replaced by a submarine cable. The license of the radio "talk bridge" expired on August 1, and the Department of Commerce had requested that its operation be discontinued, making its wave-lengths available for broadcasting. The capacity of the ether for radio messages is distinctly limited and when such services as broadcasting ship-to-shore telegraphy and telephony, radio compasses, etc, which can be handled only by radio, have been accommodated, the available wave-lengths of the ether are about exhausted. Consequently, the change from radio to cable in a case like Catalina Island, where the cable is not only feasible but more economical than radio, is for the good of the service

Reducing Guesswork in Tuning.—The chief of the radio section of the Bureau of Standards has published in the July issue of *Radio Broadcast* an article entitled "Reducing the Guesswork in Tuning," which gives a general statement of the methods employed in establishing frequency standards and making them available to the public. The Second National Radio Conference recommended that radio broadcasting and other transmitting stations operate accurately on the frequencies to which they were assigned The attainment of the necessary accuracy is made possible by improvements which have been carried out during recent months at the Bureau of Standards in its frequency measurements. Standards of frequency can now be furnished which permit the setting of transmitting stations on the correct number of kilocycles. The fundamental frequency basis has been established by four independent methods of primary standardization. The frequency standards are furnished through the transmission of standard frequency signals which have been described in recent issues of the *Bulletin* in the testing of wave meters, and in the measurement by the Bureau of frequency of various transmitting stations, the frequencies of which are known to be kept constant.

Radio in France.—Even in conservative France radio broadcasting has taken quite a hold Any private person can now own and operate a radio receiving set, although an annual fee of 10 francs is charged by the French postal authorities to all owners of radio receiving sets. Special licenses are required for the operation of transmitting sets. Broadcasting is carried out in the Paris region by the Eiffel Tower, the Société Francaise Radio Electrique, and the Superior School of the Postal Telegraph and Telephone Services of the Government. The length of wave used by the Eiffel Tower is 2000 meters, the principal items broadcasted being weather reports, stock exchange news, and a radio concert every evening, according to *Electrical World*. The length of wave used by the Société Francaise Electrique is 1780 meters, this company broadcasting an afternoon concert and an evening concert. The sale of receiving sets especially adapted to radio-phone reception is said to remunerate the company for its broadcasting activities. The Superior School service, also free of charge, is carried out in the interests of education and experiment. The French military authorities are starting a trial system of broadcasting on a 45-meter wave.

Kilocycles in Radio.—The Second National Radio Conference, which met last March, introduced a method of designating radio waves which may not be familiar to all those interested in radio work. This is the use of frequency in kilocycles (abbreviated kc.) instead of wave-length in meters. This practice has many advantages, and it is believed that it will eventually replace the other method of designation. The separation of the frequencies of transmitting stations to prevent interference is an important matter, and the necessary separation as expressed in frequency is the same no matter what the frequencies of the two stations may be, while it is variable and quite misleading when expressed in meters. Thus, the frequency band existing between 150 to 200 meters (2000 to 1500 kc.) is enormously wider than the band from 1000 to 1050 meters (300 to 286 kc.) While it is possible to carry on 50 simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1000 and 1050 meters. It is very simple to obtain the approximate relation between kilocycles and meters. For example, knowing the wave-length in meters, divide 300,000 by the number of kilocycles, which will give the wave-length in meters. A table which may be used for rapid and accurate conversion can be obtained from the radio laboratory of the Bureau of Standards.

Broadcasting Realistic Piano Music has long been a real problem for the radio engineer The difficulty is similar to that which has confronted the maker of phonograph records. The blows of the hammers on a piano are distinguishable, but the singing quality and the overtones which are relatively weak have not been properly reproduced through loud-speakers and telephones in the past. Engineers connected with the WGY studio at Schenectady have devoted a good deal of time to the solution of the problem, and they have now developed a device which will make the piano solo a real feature of the broadcasting program. The device, in brief, consists of a magnetic system between the poles of which is pivoted a suitable coil system. The magnet is firmly fastened to the frame of the piano and the coil is anchored to the sound board. By means of this pick-up device all tones in the piano are faithfully converted into corresponding electric currents which control the radio transmitter. When heard on the loud-speaker the piano is no longer a tinkling sound. The listener gets all the characteristics of this percussion type of instrument, such as the blow of the hammer, the singing tone and the overtones. The piano pick-up is free from the familiar hiss of the carbon microphone as well as the objectionable blasting that takes place when an artist plays too loudly for the microphone. When the carbon or condenser microphone is used to pick up a vocal solo with piano accompaniment the problem is to place the microphone in such a position that it picks up both voice and instrument in their proper ratio. The position of the microphone must be changed for each artist. The radio listener has probably noticed that as the singer increases the volume the accompaniment fades out; in other words, the soloist "paralyses" the microphone. When the piano magneto-microphone is used the intensity of the piano may be adjusted electrically in the control room, even while the selection is being rendered, as the voice is recorded on the customary carbon or condenser microphone. In the grand piano at WGY there are three of these devices; one in the extreme treble, one in the middle register, and one in the bass. The three outputs can be readily balanced in the control room for the best results [illegible] any way with the instrument.

Radio Notes

A New Antenna Cable recently developed has shown that by its use the audibility of signals can be increased by nearly 40 per cent. The conductor is composed of ten strands of No. 18 bare copper wire braided closely together on a special machine to give it a ribbon like appearance, one-half inch wide by one-eighth inch thick. With an antenna 30 feet long of this type, strung in a basement at a level about one foot below the surface of the earth, better results were obtained than with an antenna of the usual type of 100 feet length, strung between two poles out of doors at an elevation of about 40 feet.

Motor Ignition and Aircraft Receiving Sets.—From a recent issue of *Elektrotechnische Zeitschrift* we learn something regarding the interference caused by the usual ignition system of an aircraft engine with the reception of radio signals aboard such aircraft. This interference is especially marked when several stages of amplification are employed, and is most troublesome at short wave-lengths. The German author states that a complete metallic shielding of the engine, including all high-voltage and low-voltage connections, gives in most cases a satisfactory solution, although such practice complicates the engines and makes them less accessible. A new system is mentioned, by means of which the amount of emitted electromagnetic energy is completely compensated, resulting in what is claimed to be absolute relief in all cases. However, details of this new system are being kept secret for the present.

The UV-199 Tube is an extraordinary tube. It appears that the filament requires but 18 watt, or approximately 1/27th of the energy used in the usual UV 201 tube. Yet the characteristics of the new tube are slightly better. The filament of this tube runs at a temperature about 400 degrees cooler than the old type of tube. It is interesting to note that 14 different chemical elements are utilized in this tube besides traces of several others. The filament wire is extremely small, being but one-fourth of the diameter of an ordinary hair, yet the fact is that this wire has the strength of the best steel piano wire. The filament is not a coated one, but it has the high efficiency of electron production of the coated filament and the uniformity of operation and the ruggedness of the tungsten filament. If the filament is operated at too high a temperature the electronic emission falls off and the tube becomes inoperative. However, by operation at rated voltage with the plate voltage off for a period of time normal electronic emission can be regained. Thus improper filament operation does not spoil the tube beyond recovery. Three cells of dry battery, even the small flash-lamp type, furnish the necessary current for the filament.

Broadcasting in Sweden is now receiving careful consideration, based on the experiences of other countries which may be drawn upon quite liberally at this late date. It is understood that a Swedish company has proposed a plan to the Swedish Government. This company seeks a joint monopoly with the Government in the matter of radio broadcasting. The plan provides for extensive cooperation with the Government, which is to erect transmitting stations successively. These stations will be at the disposal of the new operating company at least five hours a day for an annual fee corresponding to 6 per cent of the cost of construction of each station. In addition, the company must pay for the power as well as for the tubes used. It is suggested that individual owners of receiving sets be required to pay an annual license fee of 20 krona, or about $5.40, and that societies, places of entertainment, and so on, pay a maximum license fee of 1000 krona. Any make of receiving set may be used. The radio entertainment program includes general news, economic reports, weather reports, lectures, music and so on. On Sundays religious programs will be given. Regarding the broadcasting of advertising matter, the new company endorses the Government's recommendation that this be limited. It proposes that such material be of the type usually run in newspapers as reading notices. The danger of unfair competition with newspapers in the distribution of news will be avoided through cooperation with the Central Cooperative News Agency of the Swedish press, which will select and edit all the news. The Government is to have full rights at all times to broadcast urgent reports, even during the company's allotted period, without charge.

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followed. The vital errors of the common crucible method are obviated. In order to avoid the drawbacks due to the waste space above the coal and the excessive amount of heated surface in contact with the gas and vapors in the crucible test a small, cylindrical quartz glass vessel is used and the heat is applied to the coal itself and not to the volatilized products. The waste space above the coal is done away with by introducing a piston which rests on the powdered coal and fits loosely into the outer cylinder in order to allow free exit to the gases and vapors. The heating is done by means of a platinum resistance coil wound around the heating tube. The practical value of this apparatus lies principally in the fact that the coke obtained brings out the peculiarities of coal in a much more striking fashion than does the coke in the crucible test, owing to its shape.—*Fuel in Science and Practice*, 2 5, pp. 152-5.

The Francois Cementation Process which has enabled shafts to be sunk and tunnels to be driven through every kind of water-bearing strata consists in permeating every crevice with concrete under high pressure. When test holes indicate the presence of water ahead of the digging, pipes are cemented into them and through these pipes bore holes are sunk with a diamond drill. On the tapping of water feeders the boring is stopped and the pipe in the hole is connected to a cement pump. Into the holes cement pulp and mixtures of chemicals are pumped at pressure. The ground is treated thus until the desired length of ground has been rendered sufficiently watertight to allow sinking and walling operations to proceed. Then the ground is excavated in the ordinary manner and reinforced concrete walling is built up. On the walling being completed a second length of ground is excavated and walled, this procedure being continued until the water-bearing strata have been passed through.—*So Afr Mining and Engineering Jour.*, 34 1664, pp. 380-1.

Extinguishing Coal Mine Fires with Carbon Dioxide.—When a mine chamber, which is on fire and whose atmosphere may have reached quite a high temperature is sealed off to smother the fire, the fire may be so greatly reduced that little heat is generated. Therefore the air in the chamber cools off and contracts, reducing its pressure quite considerably. The differential in pressure often causes outside air to force itself into the chamber through small openings, feeding the fire anew. In the case of a mine in Pennsylvania 1440 cylinders, each containing 50 pounds of carbon dioxide, were introduced into the sealed chamber by way of bore holes in order to balance this differential in pressure, some surface leaks first having been sealed. Gas samples were from day to day taken through small pipes, while inside temperatures were taken by means of thermometers. In all, 280,000 pounds of carbon dioxide were used in a total period of about three months. Some water was used, not to extinguish the fire but to cool it, and it was not applied until gas analysis indicated that all flame had been extinguished, so that steam and water gas could not result. The fire was successfully extinguished and the mine is being worked. The expenditure for gas was less than 10 per cent of the total sum spent, the remainder being largely the cost of the direct method of fighting.—*Coal Age*, 24 1, pp. 8-10.

A New Method of Screening Coal which doubles the capacity of a given screen has been worked out by F A. Krehbiel, who made a critical study of the progressive movements of coal across perforated screening plates and observed that the difficulty in attaining high screening capacity is found in separating the final portion of a smaller size from the next larger size. This is caused by the tendency of small particles to remain entrained in the mass of over-sizes and thus be carried along beyond the perforated plates before they have settled through the large lumps to the bottom of the stream of coal moving over the screens. If the oscillating screen has a long swing, coming gradually to rest at each end of the stroke, there will be but little agitation, and the coal will move forward in one compact mass without permitting much of the fine coal to escape downwards between the lumps. To remedy the fault, steps were interposed in the screen plates and these served to break up the mass at intervals, greatly hastening the screening and doubling the capacity of the screens. In

(Continued on page [illegible])

20 of the world's finest Turkish cigarettes for 30¢—*a triumph in volume production*

Try them tonight for your Luxury Hour

—that easy chair hour when every man feels entitled to life's best

PALL MALL *Specials*
New size—plain ends only
20 for 30¢

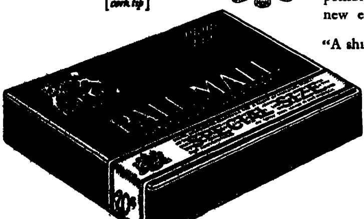
No change in size or price of PALL MALL *Regulars*
[cork tip]

Wherever men smoke, Pall Mall is known as the aristocrat among cigarettes. Its exquisite blend of the choicest Turkish tobaccos has never been successfully rivaled.

Now Pall Mall comes to you in a new size package—priced so moderately that even the thriftiest may smoke it consistently—a super-value Pall Mall—made possible by greater output and new efficiency in manufacture.

"A shilling in London—a quarter here!" The world has gladly paid that for ten Pall Mall "Regulars." But a nickel more buys 20 of the new Pall Mall Specials—slightly smaller in girth, and with plain ends, but with the inimitable Pall Mall quality left intact.

Try them tonight in your easy chair hour—that hour after the day's work when men demand the most from a cigarette. Give Pall Mall the "Luxury Hour" test. Soon you'll smoke them exclusively. New size in plain ends only.



20 *for* 30¢

WEST OF THE ROCKIES 20 *for* 35¢

Scientific American Digest

(*Continued from page 286*)

addition, it was discovered that a greater efficiency was obtained by a progressive increase in the velocity resulting from increasing the sloe of the screens.—*The Coal Industry*, 6-7, pp. 317-9.

Natural History

Bird's Egg in Banana Bunch Travels 1100 Miles Safely.—A grocer of Cape May, New Jersey, received a bunch of bananas from Cuba in which there was a bird's nest containing one egg. The egg was not broken although it had come 1100 miles.

Resumption of Fish Culture in Russia.—From a recent letter addressed to the Secretary of the American Fisheries Society by M Novorusski, director of the All Russian Agricultural Museum, formerly the Imperial Agricultural Museum, at Petrograd, we learn that the long inactive fish-cultural apparatus at the museum has again been utilised. Mr Novorusski states that, with the cooperation of the chief administration of the fishery and pisciculture trade, there was founded last autumn in Petrograd, on Krestovsky Island, the first State fish hatchery Though the early approach of winter prevented the best results, 2,000,000 eggs of *Salmo salar*, 3,000,000 of *Coregonus fluviatilis*, and 6,000,000 of *Albula fluviatilis* were obtained and successfully incubated. Mr Novorusski further states that it is the intention to materially enlarge this fish-cultural establishment during the present season

Domestic Animals in a Zoo.—We once shocked the learned director of an eastern "Zoo" by suggesting that domestic animals would perhaps prove as educational as the ocelot, but he frowned sternly on the idea. Zoological parks were for wild animals alone. Our judgment now proves to have been good for something after all. Following suggestions that a cow and a pig be placed in the St Louis Municipal Zoo, because many St. Louis children have never seen either, superintendent of instruction Maddox instituted a poll of sixth grade pupils He announced that of 5376 children questioned 40 per cent had never seen a sheep and 17 per cent had never looked upon a pig Twelve children out of every hundred had never seen a cow

Alberta Bird Sanctuaries.—Seven bird sanctuaries have been established in the Province of Alberta by the Canadian Government in cooperation with the provincial authorities. Completion of the Saskatchewan sanctuaries is near and a survey is to be made to locate suitable areas for bird sanctuary purposes in the Province of Manitoba.

A "Monkey Mountain".—The Park Commissioners of Milwaukee, realizing that monkeys entertain and hold the attention of visitors to the Zoological Garden longer than any other exhibit, erected an oval shaped mound, suggestive of a mountain, 127 feet long and 82 feet wide, where the primates may be viewed under as nearly natural conditions as possible. On the south side of the mound a concrete cave was constructed with an alcove facing south. This gives a large open space, protected from the north, west and east winds in the early spring and late fall. At one end of the mound are a series of rock shelves about four feet wide, upon which the monkeys disport themselves and where they also receive their food. From the highest point on the mound a rivulet flows, winding its way westward over rocky precipices to a moat below, where it terminates in a fairly extensive sand beach, on which the monkeys can bask in the sun. The entire surface of the mound, with the exception of the sand beach, is sodded. The moat surrounding the mound is 80 feet wide, on its outer side a wall has been so constructed as to prevent the escape of the monkeys should any attempt to swim across the moat. The place is so arranged that it is possible for 4000 visitors at one time to enjoy the interesting antics of the monkeys under natural surroundings.

A Natural History Museum for Pekin.—Although the widening of our knowledge of the fauna, living and extinct, of Asia and the enrichment of the collections of the American Museum of Natural History was the major purposes of the Third Asiatic Expedition. It has not failed to recognize its opportunity and its duty of encouraging scientific activities in the country where its field work is being pursued. It has had closely at heart a project, warmly spon-

sored by President Henry Fairfield Osborn, of establishing in Pekin a museum of natural history. It is to be hoped that the recent upheaval in China will not affect this admirable idea.

Will the Nightingale Sing at Noon?—Last year an American ornithologist went to England especially to hear the nightingale sing at noon. This was the third visit for the purpose and unlike the other two was successful. The idea was so well advertised in the newspapers that the song of the nightingale was no great rarity according to the letters which Dr Wood received. The whole thing seems to be a matter of luck and those who are looking for this ornithological treat can find no better hunting ground than Surrey.

Summer Furs Again.—The wearing of summer furs has again engaged the attention of scientific societies and the curtailment of winter furs is also advocated. Among the organizations which have now started to coöperate actively with the object of arousing sentiment on the subject and later seeking legislation are the American Museum of Natural History, the New York Zoological Society, the Boone and Crockett Club, the American Game Protective Association, the American Bison Society, the National Association of Audubon Societies, the United States Biological Survey, the National Park Service, and the American Society of Mammalogists.

The Fox Industry.—Fox raising has been so profitable in Prince Edward Island that the industry is now extensively carried on in Southeastern Alaska. The shipment of furs and skins amounted to more than $3,300,000 last year. Most of this amount is represented by blue and silver foxes.

How Moles Live.—The American Museum of Natural History offered a prize of $25 for a nest which would show how the mole lives, and several were forthcoming. Dr F. A. Lucas, Director of the Museum, said accurate information hitherto not available to scientists, had been secured. "This is the first authentic information about a mole's nesting habits that I know of," he said, "and as far as I know the groups which we can make out of our specimens will be the first in any American museum. I had been unable to find any one who knew anything about the family life of a mole until I received the accurate information of the finders of the nests we now have." Dr Lucas plans to use the newspapers in further hunts for unusual specimens of animal life. He said that for three years he had been trying to get hold of a family of young raccoons under a month old. In spite of a reward of $100 for such a family he has never been able to get one. He is also after a family of young wolves.

An Aquarium for London.—Aquariums have come and aquariums have gone in London, probably because they were commercial ventures and were not handled by scientists. Now, however, the Council of the Royal Zoological Society have decided to provide an aquarium in London under the direction of a trained biologist. The Marine Biological Station at Plymouth is a long and fairly expensive journey from London. It is very fitting that the Royal Zoological Society should sponsor the undertaking as the New York Aquarium is also under control of the New York Zoological Society.

Prevention Better Than Dentistry.—The Royal Zoological Society which runs the "Zoo" in Regents' Park has a new curator and one of the first things he did when he assumed office was to put the apes on a diet of hardtack so as to save their teeth, which were becoming loosened on a diet of bananas, potatoes, oranges and bread. The trouble seemed to be a loosening of the teeth like pyorrhea. The unwilling boarders at the Zoo take to the hardtack and seem to prefer it to the soft food.

Archaeological

Early Postal Service.—The history of the postal service goes back as far as the sixth century B. C. and may be called the handmaid of civilization. We can trace it from the dispatch bearer of the Assyrian and Roman times to the airplane service of the present day. In the Book of Esther in the Bible you will find how letters were sent thousands of years ago. There it tells of how King Ahasuerus, learning from Queen Esther that Haman had ordered the death of all the Jews in the land, commanded Mordecai to call together the scribes and send letters to every province of the kingdom

forbidding the massacre. This is the verse that describes the sending of the messengers:

"And he wrote in the King Ahasuerus' name, and sealed it with the King's ring; and sent letters by posts on horseback, and riders on mules, camels and young dromedaries."

The Romans, too, sent their letters by mounted messengers, or "couriers" as they were called. The courier carried the message about 20 miles when he would come to a "posta" where another messenger was stationed with a fresh horse. He, in turn, would be relieved by still another courier when he reached the next post. Thus relay after relay the letter was sped on as fast as man and horse could carry it until at last it arrived at its destined "posta," meaning station or stopping place, and it is from that word that we obtain the word "post" as found in post office, postcard and many similar words.

The Photographing of Palimpsests.—The ultra violet rays have been found very useful in photographing palimpsests (writings written over older writings) The textual results of fluorescence photography exceed those of earlier processes by 50 per cent.

Trenches Overlook the Tombs of Hector and Achilles.—The recent conflicts in Asia Minor have brought historic ground into the fray At Chanak, British soldiers in their trenches overlook heroic ground. A few miles westward the ruins of Troy dot the treeless plain, and nearby two gigantic mounds of earth, designated by tradition as the tombs of Achilles and Hector, overlook the sapphire sea Are these famous fields where Greeks and Trojans fought destined to be the initial battleground of another great war?

Gold Teeth Ornaments in China.—A curious custom is mentioned by Mr William L. Hall in *Asia Magazine* In a village street sat a man selling gold teeth. He had a number of molds of different shapes and sizes. These are slipped on over sound teeth and worn as ornaments. Prospective customers fit the molds on their own teeth and watch the effect in a small mirror provided by the tooth merchant. When a fit is found, or a tooth that suits a special fancy, the price is discussed If an agreement is reached, the customer pays the bill and goes away with his new possession in his mouth, but if no trade is made, the tooth is thrown back into the pile and held for the next customer

Discoveries at Ur.—"Ur of the Chaldus" is giving up valuable archaeological material. Brick walls believed to have been erected 36 centuries before the Christian era have been discovered among the ruins of Ur It is believed that these ruins comprise the temple of the Moon God and his consort, part of which were brought to light in 1918. The discoveries in that year uncovered the bachelor quarters of the god, while the ruins now found are believed to have been his "harem" A fragment of a stone vase has been dug out, upon which is a representation of the moon and his goddess receiving the adoration of worshippers. The carving is believed to have been done 2000 years before Christ. The excavators also discovered in the inner room of the temple some jewelry of the period of Nebuchadnezzar, who rebuilt the shrine in the sixth century B. C., carefully preserving the original plan.

A Royal Archaeologist.—The Crown Prince of Sweden is an ardent and practical archaeologist and spends much of his time excavating the buried town of Asir in Greece.

King Solomon's Aqueduct Leaky.—Two of the reservoirs built by King Solomon have been cleaned out, and are being used to supply Jerusalem with fresh water by means of an aqueduct which passed through Bethlehem. The masonry work done by the great Hebrew King's men has proved to be very leaky, which is little wonder considering the length of time which has elapsed since the original construction, and money has to be spent now right along to keep it in repair.

3000-Year-Old Woolen Cloak Found in Sweden.—Leading European archaeologists are of the opinion that a woolen garment, resembling a cloak, discovered by peat cutters in Gerum Fen, near Skara, Sweden, is one of the oldest ever found in Europe. It lay only a few feet under the surface of the peat but the preserving qualities of the fen water kept it intact, scientists believe, for about 3000 years. Although it is said to be the first complete garment ever found, the British Museum possesses several fragments of cloth dating from even earlier periods.

Travel and Exploration Notes

The Duck-Bill Platypus With Us.—That curious and temperamental bird mammal the duck bill platypus so rare to find in captivity has been brought to the New York Zoological Park recently from Australia and is now becoming accustomed to the new environment.

Stefansson's Progress.—After staying a year on Wrangel Island in the Arctic Ocean the advance guard of Stefansson's exploration and development expedition to the Far North is to be brought back to home on the power schooner Nokatak. The party which landed on the island last summer is said to have hoisted the British flag and claimed the territory for Great Britain. Previously the land has been regarded as Russian territory according to ship captains familiar with the Arctic.

Return of "The Quest."—"The Quest," with the Shackleton Rowett expedition has left Cape Town and arrived at Simonstown on July 7. After a few days there she sailed for home via South Trinidad and Rio de Janeiro. It is proposed to spend two days at South Trinidad the uninhabitated volcanic island in the South Atlantic. The island has been frequently visited notably by the Discovery in 1901 and the Valhalla in 1905. At an earlier date it obtained fame by reason of several searches for buried treasure. The Quest is expected at Plymouth early in the fall.

Explorations of the American Museum of Natural History.—During the present year a larger number of expeditions have been sent out by the American Museum of Natural History than ever before. Visitors to the Museum may follow the movements of these expeditions by referring to a map of the world hanging in one of the corridors with labels showing the location of the exploring parties. A glance at this map shows Ecuador, Brazil, British Guiana, the Dominican Republic, the Society Islands, Queensland, Australia, Newfoundland, Aztec, N. M., as well as widely different points in Europe and the United States included among the places where work is in progress at present or is definitely planned for the near future.

Fur Bearing Animals in Captivity.—Important progress has been made in investigations pertaining to the rearing of wild fur bearing animals in captivity. Fur farms are reported from twenty five States where foxes, skunks, raccoons, minks, opossums, martens, muskrats, squirrels and beavers are raised. It is estimated that 500 ranchers are raising silver foxes in the United States, that they have between 12,000 and 15,000 foxes in captivity and that the value of the investment is about $8,000,000. The discovery of the fact that martens breed the last of July and in August has solved the problem which has heretofore prevented the successful rearing of these animals in captivity and has opened up an important field to the fur farmer.

Shackleton Aid Says Airship Could Go to Pole and Back Within a Week.—Future polar exploration to be successful must make use of the air according to Major C. R. Carr, a flying officer attached to the Shackleton Expedition, who has just returned to London in advance of his comrades on the quest. Very few people realize how mild the Arctic and Antarctic summers really are or the wonderful improvement in aircraft, he says in the *Public Ledger*. The German airship of today is capable of doing a trip to the North Pole and back from London, a distance of more than 4000 miles, within a week. Fuel for the whole journey could be carried and no landings made. This proves that before long we will have Polar exploration without years of work and hardship. During the seven weeks they were in the ice the lowest temperature recorded was five degrees Fahrenheit and the average was approximately 20 degrees. The wind averaged from eight to ten miles an hour and the air and sky were wonderfully clear, so clear that mirages were frequent. The records he kept showed that they had more than 300 perfect flying hours. In conditions such as these the airplane could have been used without difficulty. At 69 degrees 18 minutes south they were blocked from going farther by ice. It was here planes could have done valuable work. Soundings showed the shoaling of the sea from 3000 fathoms to a little over 1000 indicating that they were approaching the Antarctic Continent. It was the opinion of all on board that had they been able to fly south of this point another 100 miles, they would have discovered new land.

Travel and Exploration Notes

Desert Sheiks "License" Buses.—Motor omnibuses are now running regularly between Bagdad and Aleppo, although the motor road is officially unprotected. The distance between Bagdad and Aleppo, via Mosul, is roughly 560 miles. The buses seat eight passengers. The omnibuses run via Mosul and take five days, although ordinary cars traveling up the Euphrates Valley take only three days. The principal desert sheiks have undertaken not to molest the omnibuses in return for a lump sum down.

Robinson Crusoe a Dutchman?—Idols are being smashed with great regularity these days. Eleven years before Defoe landed Robinson Crusoe on the inhospitable shore, one Hendrik Smeeks, a Dutch surgeon, wrote a book of adventure which parallels the English Robinson Crusoe so closely that the claims of the prolific English writer may be scanned very carefully before we reject "Sjouke Gabbes" the Dutch forerunner This book has just been published in translation by Lucius L. Hubbard.

The Nizhni-Novgorod Fair Revived.—The Nishni Novgorod fair, perhaps the oldest of the world's gatherings for the promotion of trade, opened this year on the first of August. Traders from Persia, Bokhara, Turkestan, Afghanistan, Mongolia, and the Far Eastern Republic were encouraged in all possible ways to come and bring their goods, and Russia was represented by a number of state trusts and syndicates, Soviet economic councils, and cooperative societies. The fair dates back to the fourteenth century It was then held at Kasan For the last 100 years it has been held at Nishni-Novgorod, a small town at the junction of the Volga and Oka Rivers, about 265 miles east of Moscow

MacMillan Party is Safe in Arctic.—News that the Arctic expedition headed by Donald B MacMillan spent the winter in southwestern Baffin Land and was successful in its observations in terrestrial magnetism has been received at Portland, Maine The radiogram, dated July 27 said that all members of the expedition were well The radio receiving outfit installed on the schooner "Bowdoin" has proved ineffective. The message, sent out from Nascopie by way of Fogo Island, Newfoundland, reads as follows "Wintered southwestern Baffin Land Observations successful Operation beginning November Sixteen field stations. No polar light photography, hope secure some Labrador Can wireless us through Fur Trade Commission messages delivered Dorset." Cape Dorset is on the southwestern coast of Baffin Land and at the upper end of Hudson Strait

A Patagonian Fossil Hunt—A five-year hunt for fossils of extinct species of mammals which appeared ages ago, will be begun in October when Prof Elmer S Riggs, associate curator of paleontology of the Field Museum of Natural History, of Chicago, and three assistants will sail for Buenos Aires on the first leg of their expedition After exploring the Argentine pampas, the party will strike southward along the Atlantic Coast as far as the Straits of Magellan In places the work will be along beaches where the ledges are accessible only a few hours each day In the extremity of Patagonia, a land of strange legends and folk-story, the party will search for fossil remains of unique and much more ancient animals, which existed in South America in the ages when it was almost as widely separated from North America as Australia is now separated from Asia. This isolation accounts for strange fossils.

Across the Empty Continent.—Two explorers, 70-year-old twins, by the bye, have just crossed Australia from South Coast to North Coast and back covering nearly 6000 miles in 67 days with three motor cars. The explorers passed through vast stretches of country without sign of man or beast, an experience, Captain White considers, which most strikingly justifies the late Lord Northcliffe's lament over the folly and menace of the "Empty Continent." Mr McCallum, one of the two brothers, says he was amazed at the abundance of fertile country through which they passed in the interior, and mentions one plain, 150 miles long and extending east and west as far as the eye can see, consisting of splendid alluvial soil. They passed through superb pastoral areas with many rivers available for huge irrigation schemes, but the development of these lands would be absolutely dependent upon the building of a direct north-south trans-continental line.

Protecting Our Great Banks

(Continued from page 223)

of trained assistance and the fullest liberty of action and freedom from interference. Candor compels this confession

Many bankers, when made acquainted with this fact, have recoiled from expensively constructed vaults and taken the stand that much cheaper structures will hold back the expert cracksman for just as many hours. Here again is a truth. The same expert who can make his way through the finest vault wall yet designed in, let us say, five or six hours, will require just as much time to get through much simpler and far more economical barriers.

But the man who stops his reasoning here and puts in the cheaper vault is deluding himself, none the less. His cheap wall may resist for just as many hours as the great metal and concrete walls recommended by the engineer, but there are ten thousand burglars and a hundred thousand ordinary mechanics in the country who can breach his cheap wall in a few hours with only ordinary tools, such as are easily transported and assembled On the other hand there are only six men in the United States who can make their way through the modern wall in the same length of time, and they are all highly paid experts and men of standing. Moreover, they would need for their work a huge equipment of modern tools and machinery such as could not possibly be handled or even procured by criminals.

The matter simmers itself down, therefore, to a question of odds, which stand in favor of the expensive vault in the ratio of a hundred thousand to six The heads of the great banks understand this and equip their institutions accordingly Nor can these chiefs of large financial institutions and the government officials be in any doubt Big city banks put in modern vaults which cost as much as half a million dollars and the Federal Reserve branches have spent as high as a million dollars for this kind of protection in a single bank. Such amounts are not laid out for doubtful returns.

I have already written extensively of the burglar alarms as applied to business houses and banks, but the installations of these wonderful devices used in our greatest financial institutions require special description and explanation They are not less marvelous, in their way, than the vast vaults of which they are now an integral part. My readers must already understand that the lining of a modern vault is electrically connected with an alarm which goes off either if this lining is perforated ever so slightly or if it is fused by heat. In addition to this lining, the door, front, sides, top and floor of the modern vaults are thoroughly interlaced with the wires of the alarm system or systems, two separate installations being now employed in some of the best vaults. These wires, enclosed in leaden sleeves, are laid when the reinforcing rods and cables are put into place and the concrete is then poured over them They are similarly built into the great doors, so that every corner of the vault is interlaced with this network of alarm ringers. There are, as previously explained, two general types of such alarms the central office system, under which the alarm is given at a patrol house, and the local or public alarm system, which sets off a loud gong fixed to the front of the bank and enclosed in a steel chest to prevent burglars from tampering with it before attacking the vault. There is, of course, considerable argument as to the respective merits of these two alarm methods and it is not within my province to express an opinion on either side. The most recent vaults, as I have said, employ both systems at the same time, to make doubly sure.

Since, however, I have previously described the central office alarm at some length, it may not be amiss to go into details here with the latest developments in the opposite type of mechanism. I am indebted for the information to Mr Walter R. Whiting, the noted Boston expert on this subject. In addition to the vault lining and the wiring in the doors and walls of the vaults, used to protect against nocturnal burglars, there are push buttons scattered throughout the banking room and in various other parts of the institution, pressure on any one of which will set off the general alarm instantly in case of a daylight intrusion.

The whole system is controlled by a series of batteries, placed inside the vault and attached to a time lock similar to that which operates the main vault door These batteries control the trigger of the alarm, which is in turn propelled by powerful springs. The very light current in the delicate wires

of the alarm merely balances the trigger and releases it if the slightest interference occurs, if there is a short circuit or if a battery is out of order. An indicator on the front of the vault shows the condition of the batteries at all times.

But, as one of the most eminent of vault engineers told me the other day, this kind of alarm system is employed not only and not even mainly against the burglar but against other risks, such as human fallibility and the collusion of bank employes or officials. It is this part of the alarm's function that is most interesting.

In the United States Treasury at Washington and the Federal Reserve banks indicators of the alarm system are placed in the room of the bank officers, so that the condition of the vaults and the protective mechanism is always under the eyes of the officials. Another improvement that was originally used in the Boston branch and is now being installed in the New York Federal Reserve Bank is the connection of these indicators with the combination locks of the vault doors. Thus the officials, in their interior room, will always know whether the combination locks have actually been mixed up when the doors are closed for the night.

Again, there is a switchboard with indicators in the office of the captain of the watch and to this are attached a number of smaller alarm gongs which are set off in case any member of the watch or any other person should attempt to tamper with the locks in the course of the night. This switchboard in the watch captain's room is really a thing of wonder. When any of the vault doors is opened, day or night, a red light shows on the board and continues to show until the captain turns the switch. At the same time a record of the time of the vault's opening is mechanically made, so that it cannot be altered. Similarly, a white light shows when the vault door is closed again and a record is again made.

Inside the vaults, each one of the strong-boxes or compartments is electrically connected. The clerk or officer in charge of the vault has the combination of each such compartment and can open it without disturbing the alarm system. But if any attempt is made to open such a box either by force or by tampering with the combination, the alarm in the watchroom and the general alarm outside the bank go into immediate and deafening action. Again, if the compartment is properly opened by the person holding the combination, a device in the watchroom flashes a red light on opening and a white light on closing and makes a record of the time at which each compartment was locked and unlocked.

Even the entrances to the bank building are connected with this master switchboard and no one can open or close any of the doors without leaving a record.

In the New York Federal Reserve branch a still more intricate device is being employed, called by its manufacturers a remote time-lock inspection device. This apparatus connects with every time-lock on every one of the vault doors and with the time-locks of the alarm systems, showing at all times the condition of the locks. This, too, connects with the general switchboard in the office of the captain of the watch. If any time-lock runs down or runs slow or fast or is tampered with in any way, the watch captain is instantly aware of the fact.

In the New York branch a mechanism has also been installed to provide against the accidental or purposeful presence of any person inside the vaults after the doors were closed and locked. Accordingly, a number of electric switches have been placed in various parts of the three great vaults and the vault patrol must go through the vaults and throw every one of these switches before the officers having in charge the locking of the vaults can close the doors for the night. If the vault watchman fails to make a complete tour of the interior and throw all the switches the indicator on the front of the vault and another on the switchboard in the watch captain's room will betray this neglect. Finally, the clocks of the time-locks themselves are connected with the switchboard in the guardroom and if any person should tamper with the time-locks during banking hours and attempt to reset them, so that the vaults might open earlier than honestly intended, that fact would immediately be communicated to the watch captain by means of an alarm gong and red lights. Surely, precaution can go no farther.

The fallibility and occasional dishonesty of bank employés or officers explains the necessity for such extremely complicated alarm devices. But what shall be said about these million-dollar super-vaults, which no burglar can hope to enter under police conditions such as exist in the great cities where these vaults are alone employed?

No great bank has been burglarized in forty-five years. No serious attempt has been made for a generation. Cities are so well policed, day and night, that burglars cannot move about with such tools as are necessary even for the burglary of petty banks. Why, then, provide vaults which can only be breached with a carload of tools and special machinery and then only if no policeman interferes?

The answer is, of course, to be found in the principle of guarding against the burglar genius and the unforeseen. The former is an improbability. But who shall foretell events? War, riot, mob-law and revolution are all things which the custodians of the nation's negotiable wealth must take into consideration. Thus it is not going too far to say that the modern burglar-proof vault wears an euphemistic descriptive. The burglar enters into the problem only theoretically. The invader and the rebel are the real enemies against whom these forts are reared.

With the Men Who Fly

(Continued from page 287)

tion, owing its inception to the wonderful work of Dr. Gustaf Dalen, the Swedish Edison, who lost his eyesight in the completion of his experiments to give light to others. The problem in the use of these smaller lighthouses is to secure an intermittent flash of light, which shall operate with absolute regularity for long periods of time without any attention, and this has been achieved in remarkable fashion. Acetylene gas is used as the illuminant, stored in large tanks. A tiny continuous pilot light is fed by the acetylene from the storage tanks. Then, by a delicate system of gearing as compact as that of a small clock, an intermittent flash is created as the gas is fed in larger quantities at regulated intervals.

Another most remarkable invention of Dr. Dalen is embodied in the lighthouses constructed by the American Company. This is the sun-valve. It would be expensive to allow the lights to burn continuously day and night. It is less expensive, but more troublesome to supply attendants to ignite the lighthouses when required. The sun-valve obviates these difficulties. The sun-valve is operated by solar radiation. It is placed on top of the air lighthouse, and embodies substantially a central black body surrounded by highly polished pillars. Light is absorbed by the black body and reflected by the polished columns. Since light means heat when absorbed, the black body expands more under the influence of the sun's rays, and this difference in expansion virtually operates a trigger which opens and closes gas valves, turning gas on and off according to the prevailing degrees of light and darkness. An eclipse is sufficient to operate these lights.

The aviation routing beacons are smaller, also using acetylene gas but without a sun-valve. They are 10 feet above the ground to avoid ground air-currents, and are visible a distance of three miles. They should be particularly useful for low flying in fog to keep the aviator on the correct route.

The ground wind indicator is a most important adjunct to every landing field. The flashing light and the lens are of the same character as in the great lighthouses. However, in this case, the light is reflected on three vanes in the form of a gigantic T, and the entire device automatically swings on ball bearings so as to remain head-on to the wind. Thus the ground wind indicator will not only mark the field for the aviator, but will show the direction of the wind. The ground wind indicator is also equipped with the sun-valve and is automatic in action, being equally useful by day or by night. These ground indicators are to be used in conjunction with lights delimiting the field, and are themselves visible a distance of twelve miles, while the shape of the indicator and its bearing can be easily seen from a distance of two to three miles.

To complete the arrangements for night flying yet other apparatus will be employed. Thus on the lower wing tips of the plane are two lights, small but powerful, each of which produces 250,000 candlepower. On top of the hangars another type of flood light throws a pattern of light on the field, high enough to prevent any glare in the eyes of the pilot and enabling him to land facing the beam without any difficulty. Two cinder runways, 2000 feet long, bisecting the field, are also outlined with lights sunk in the ground, and covered with glass well [illegible] from breakage.

The Six-Meter International Cup Race

(*Continued from page 231*)

tions of strong winds and rough water, in which the British seem to be at their best, and the cup remained for a year on that side of the water. In 1922 races were held on Long Island Sound, and the winds which were light in the early races ran strong in the latter contest. In the earlier drifting matches, the American boats pulled for a long lead, which the British boats cut down in successive races, although they failed to hold the trophy. This year the races were held between the Isle of Wight and the mainland, and again the Englishmen were favored with weather to their liking.

In these races each team consists of four boats, and the scoring is by points. The first boat home is credited with eight points, the second with seven, and so on to the last, which scores but one point. The American team included "Lea," "Clytie," "Hawk" and "Ingomar"; in the English team was "Coila III," "Reg," "Sussetta," and "Capelle"

In the first race, sailed in strong winds and rough sea, with all boats reefed, the scores were America 13 points, Britain 23. In the second race the weather is described as squally with very confused sea score, America 10 points, Britain 26. The third race was spoiled by light and fluky winds and calms, in which luck played a decisive part, score, America 13 points, Britain 23. The fourth race was sailed in a 12 mile breeze, freshing toward the end, result, America 12 points, Britain 24 points. The fifth race was America's day for in a light but steady breeze, and with much windward sailing, the score was America 26, Britain 9, one British boat failing to finish at all. The last race was sailed in a strong northwesterly wind, with the result that the British led again, the score being America 12, Britain 24.

The total score was America 86 points to 129 points for Great Britain. The best sailing was done by "Coila III," with 39 points and three firsts. The best of the American yachts was "Lea," with 28 points.

These races emphasize the fact that, both in the design and sailing of yachts, the prevailing weather conditions in any country produce a yacht that is at its best in its own waters. If the average light weather of the Summer should prevail next year on Long Island Sound, the cup, in all probability, will return to American keeping.

Electric Welder Versus Riveter

(*Continued from page 256*)

ables us to understand at a glance what a saving of material and labor is secured by the use of the new method. First as regards locomotive construction, we find that in the year 1917 there was constructed in this country a total of 15,484 locomotive boilers and tanks, whose combined weight was 571,200,000 pounds. Into their construction entered some 28,655,000 rivets, and, according to Mr W C. Symons, writing in *Railway and Locomotive Engineering*, the amount of extra metal necessary in a riveted seam is as much as 12 per cent in locomotive boilers and 6 per cent in tanks.

It was natural that the shipbuilding firms should assume a conservative attitude to electric welding when it was proposed to apply it to the construction of steel hulls. The early work in this direction has been confined to small units, such as tug boats, barges and small sea going vessels, but these have been sufficiently long in service, and have been exposed to such rough usage as to demonstrate that not only is the electric weld perfectly reliable, but that, in cases where the vessel has been damaged and the plating distorted, the welded seams have shown a toughness and tenacity superior to riveted work. As regards economy in construction, the Emergency Fleet Corporation's Electric Welding Committee determined that the saving in riveted and overlapped plating in a 9500-ton ship would amount in weight to 500 tons, thereby making it possible for such a ship to carry 500 tons more cargo on the same draft than would be possible in a riveted ship. The Fleet Corporation also definitely reported to the United States Shipping Board that electrically-welded ships can be built with the same strength as riveted ships; that the plans for riveted ships can be modified to adapt them for extensive electric welding, and thus save considerably in cost and time for hull construction, and that ships, especially designed for electric welding, can be built at a saving of 25 per cent over present methods, and in less time.

Lloyd's Register of Shipping has made considerable investigation of the subject, and has formulated rules for application to the electric welding of ships. It was determined that welded joints had a tensile strength of 90 to 95 per cent of the original plates as against a strength of only 65 to 70 per cent in riveted joints. That is to say, this authority recognizes a margin of 25 per cent of increased strength in welded ship joints as compared with riveted joints.

Psychic Adventures on the Continent

(*Continued from page 238*)

of similarity with the external manifestations of childbirth In the present instance the noises worked up to a climax very rapidly, then there was a faint rustling, and the medium, apparently in a less abnormal condition than a moment before, groaned repeatedly that something had happened. Dr Schwab flashed his light, and on the table was seen a rather large branch from a box tree, quite fresh I was told that this always constituted Frau Vollhard's opening apport. Though I knew the answer I asked whence it came, and was given the correct reply—"Nobody knows." It was then stated that apparently it came direct from the tree, since on clear evenings like the present one it was always dry while if it were raining outside, it was invariably wet.

The medium's pulse had fluctuated violently I did not note down the figures and have actually forgotten whether they went up or down, but as between two readings one taken as we sat down and the other after the arrival of the box branch, I recall that the higher was some 60 per cent in excess of the lower Dr Schwab's reading was not verified by any other sitter, but assuming his good faith, this would go a long way toward establishing the *bona fides* of the medium's condition of abnormality Dr Gradenwitz and I had held her hands throughout the convulsion period, and her struggles to release them seemed very realistic.

After five or ten minutes of desultory conversation, during the first of which the medium still gave evidence of physical suffering, she had calmed and seemed normal again The light was dispensed with, her hands again taken under control and the same routine gone through as before This time Frau Vollhard was even more violent than on the first occasion As her convulsions reached a climax there came a great clattering upon the table My impressions were that the object had come from over her shoulder, but I was at a loss for specific grounds for this feeling The light was flashed, and the apport found to be a pair of small slates, tied together with twine and the knot sealed with wax

The medium, her daughter and Dr Schwab at once displayed the greatest excitement and with a good deal of mutual interruption they gave us the history of these slates. Some four months previously it was stated, the intent was formed of trying the medium at slate writing, and this packet of slates had been put up at that time Placed in a drawer, the bundle had mysteriously disappeared, and had not been seen since This, if true, would make the phenomenon a sort of double apport. The slates were cut apart with great interest to see whether they carried any message They did not, but to make up for this the pencil which had been sealed up in them was missing. Of course no corroboration was, or well could be, offered for this tale I dare say the slates had been prepared and put away as described, but that they had not been tampered with in the meantime is a long leap. And the complete absence of search made it out of the question to regard even the fact of apport as in any sense proved. Both the medium and her daughter wore rather voluminous clothes of heavy black material, in which objects of considerable bulk could easily have been concealed.

The medium now claimed extreme exhaustion, but after a rest consented to a third spasm The crisis came with remarkable promptness, and the apport made a very terrifying noise as it fell upon the table It turned out to be an ordinary stone, two or three times the size of a hen's egg It was added to a large box of similar stones standing in a corner of the room When I picked it up from the table for examination it was warm—much warmer, I was sure, than it could have got through mere contact with the person of one of the sitters.

After I left Berlin, Dr Gradenwitz had another sitting, at which Frau Vollhard's

hands were held by two eminently respectable M. D.'s. After the medium came out of one of her crises, two wooden rings were found, unbroken, about the arms of the two doctors which were thus engaged. If the medium were dressed as when I saw her, it would hardly have been possible for these to have been concealed on her arm, and if we may assume that the physicians and Dr Gradenwitz examined the rings competently, we are left rather up a tree for a "rational" explanation

Having finished in Berlin, I was in some doubt whether to go to Munich or to Warsaw The former city promised a sitting with Willy Sch., the latter with Kluski. The fear that from Warsaw I might not get back in time to catch my boat at Southampton on the 28th decided me in favor of Munich, in spite of the disconcerting news which Herr Grunewald had over the telephone. He had called up the Baron von Schrenck Notzing on my behalf, hoping to arrange definitely for a seance with Willy He was informed that Willy had got tired of working for the Baron, and had skipped out — quite literally, this was what Herr Grunewald quoted the Baron as having said The Baron gave us to understand that Willy had gone home to his father, in a little village near the Austrian border, and that, under his father's management, he was now prepared to give sittings to the highest bidder

I went on to Munich, and had an interview with the Baron, during which I saw his laboratory with all its apparatus, and the wire cage in which Willy had sat while producing phenomena outside, in the room It was all as it had been described Failing to get promptly in touch with Willy and his new management, however, I was forced to come home without having sat with the most talked-of medium of the present moment.

Waterproofing Cloth by Electrical and Chemical Action

(*Continued from page 253*)

of the cloth, but just lie on the surface, as it would on a piece of rubber All kinds of cloth can be treated in this manner This is another important advantage of the process. The same machine is used, but the pressure on the cathode bars is regulated to suit and the strength of the waterproofing solution is adjusted properly Plush mohair, tent cloth, sail cloth, thick overcoat fabrics, fine woolens for clothing, duck for making white shoes, silks and satins, linens, cotton fabrics of all sorts, canvas, awning materials, the fine large-meshed bobbinette that is used as mosquito netting—fabrics of every weave and finish can be treated by this process and made perfectly water-resistant.

To determine the degree of water resistance that these fabrics possess, with a considerable degree of accuracy, a simple and ingenious instrument has been developed The cloth is cut to size and the sample is pressed up against the water cylinder Water is then introduced under pressure into this cylinder and the pressure is gradually increased until the first drop of water has penetrated through the fabric. Some fabrics will sustain as much as 15 inches of water pressure, which is more than 75 pounds per square inch, a greater pressure than the heaviest rain can produce. The fabric will not always have such high water-resistance, as the more it is washed the less the amount of water-repelling reagents it will contain. But, even after much repeated washings, it will still retain some of its waterproofing properties, for the waterproofing treatment that it receives is very effective and much more potent than is really required when the fabric is still new

The treatment does not injure the cloth in any way

Measuring with Light Waves

(*Continued from page 258*)

temperature. In order to make use of standard wave-lengths under different conditions, it is necessary, therefore, to know the effect of the air For this reason the Bureau of Standards made over 1200 measurements of the index of refraction of air for various densities and for wave-lengths from the ultra-violet, throughout the visible spectrum and to the infra-red. These results make it possible to correct all wave-lengths measured in ordinary air either to correct values in air of standard density, or in a vacuum.

Whereas a century ago a measurement made to within 1/1000 inch was extraordinary, modern science and industry has made much more highly refined measurements, not only possible but necessary Machines and instruments are now made in which the parts must be constructed with extreme nicety and for such work accurate length gages are required. Master gages whose length is guaranteed to be correct to 1/100,000 inch or even to a millionth of an inch are now used in most machine shops. The Bureau of Standards made large numbers of such gages during the war and developed optical methods of testing them so that errors (arising in their manufacture, wear, or as dimensional time changes) as small as one ten-millionth of an inch could be detected. For these tests the standard wave-lengths described above were employed.

Astronomers have learned much in recent years from spectroscopic study of the sun, planets and of the stars and nebulæ distributed throughout the universe. Characteristic spectral lines have revealed the chemical constitution of many of these heavenly bodies and displacement of lines in the spectrum have indicated their motions relative to us in space. Moreover, if a radiant body moves, en masse, the true wave-lengths apparently become shorter or longer according as the motion is toward or away from us. A motion of 1000 meters per second is accompanied by a change in wave-length of one part in 300,000 The accurate determination of these stellar velocities is based upon precision measurements of wave-lengths, since an error of only one ten-millionth in the wave-length means an uncertainty of about 70 miles per hour in the star's velocity

The International Astronomical Union met in Rome last May and adopted practically all of the Bureau of Standards work on standard wave-lengths. As time goes on, more and more precision data on wave-lengths will accumulate until spectroscopy becomes universally known as the science of eight significant figures. The importance of this can scarcely be overestimated. Modern developments (based upon the quantum theory) have opened a vista through the intricacies of atomic structure and before many years have passed we may perhaps derive many physical and chemical constants with increased precision from spectroscopic data alone

As stated before, the Bureau of Standards has measured the wave-lengths of many of the stronger lines in the spectra of neon, argon and krypton Some of these lines are associated by constant frequency or wave-number differences, that is, when the number of waves per centimeter for corresponding groups of lines are subtracted, the differences obtained are the same to one part in 10 to 20 millions of the wave-number These are explained as arising in certain combinations of electronic orbits or energy levels, and give an awe-inspiring impression of the extreme nicety of construction and radiation in atoms. If these frequency differences are regarded as fundamental constants they offer additional proof of the high precision obtained in the wave-length measurements.

The comparison of wave-lengths of light with the international standard meter bar was mentioned above. This meter bar is accepted by the world as its standard of length and 20 some copies of it serve as length standards in different nations. They are bars of platinum-iridium alloy Can such material standards be relied upon to maintain their original length? Recent intercomparisons of some of these national standards with the International Standard at Paris indicate that some of them have changed by more than one part in 300,000.

Furthermore, there is only one primary standard meter bar in existence, the one at the International Bureau of Weights and Measures near Paris. What would we do if it should be destroyed during the next war or by some other unforeseen accident? The answer is simple. We would reconstruct the standard meter from standard wave-lengths of light. That this is possible is shown by a recent experiment performed at the Bureau of Standards. Using a Michelson interferometer and our value of neon wave-lengths a scale was ruled one decimeter (nearly four inches) in length. This scale was sent to Paris and comparison with the international standard showed it to be a perfect decimeter. The same procedure can be employed to reconstruct the standard meter bar whenever it becomes necessary to do so. In fact the time may not be far distant when wave-lengths of light will be adopted as the primary standard of length for the world since these ether-wave standards are free from the liabilities of material standards to change or accident, and are furthermore specified so completely that they may be exactly reproduced at any time and in any laboratory.

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SCIENTIFIC AMERICAN

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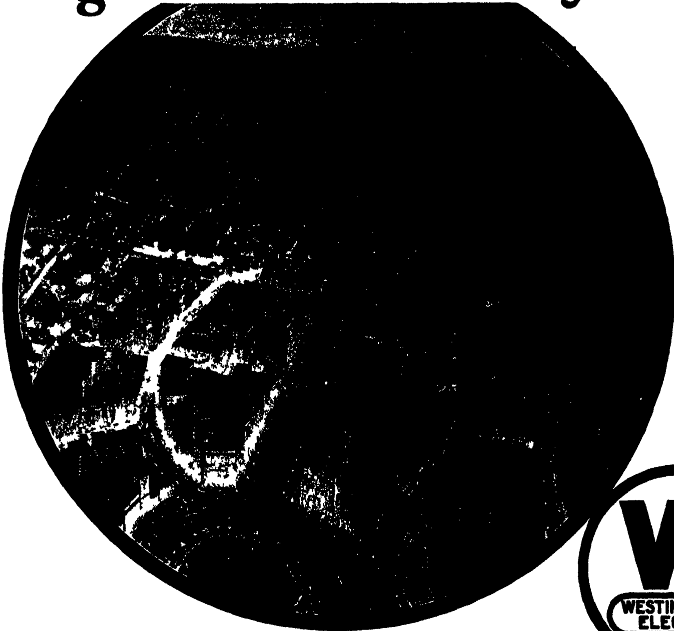
RIVETING THE PLATES OF A PENSTOCK FOR A HYDROELECTRIC POWER PLANT [See page 333]

Scientific American Publishing Co., Munn & Co., New York

The Scientific American, November, 1923, Volume 129, Number 5. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

Bright Streets are Busy Streets



ON the bright streets you find the successful shops downtown and the finest homes in the residence sections

It s there you see the pleasure seekers the attractive show windows the best hotels and theatres

It s there you can drive in safety and comfort on the best pavements or live without fear of the night prowlers that infest dark neighborhoods

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With the Editors

THE fiftieth anniversary of that indispensable tool of modern business—the typewriter—was recently celebrated. At the time we carried a full page of typewriter photographs, selected with a view to depicting the progress of this most useful invention. And now we have something more to add to our brief review of typewriter evolution. From the book entitled "History of the Typewriter," by Mares, we learn that "during the years 1847 to 1856, Alfred E. Beach, the editor of the SCIENTIFIC AMERICAN, invented a number of machines. The most noticeable feature which will strike the typist of today is the key-stem passing through the bridge, the bell-crank lever pulling the connecting wire, and the pivoting of the type-levers. With this illustration before him the operator might very well wonder wherein the inventions of the past thirty years have advanced the essential theory of the typewriter. But Beach's machine was not intended as a writer pure and simple. It was used to emboss a narrow paper tape. This tape fed through the center of the machine, and the type-bars themselves worked in pairs like a pair of tongs. When a key was depressed, the lower bar rose, and the upper bar descended, and gripped the paper between them. On one bar the letter was in relief, and in the other it was sunk, so that the paper was forced into the sunken letter by the pressure of the one in relief. The type-bars all converged to a common center, and the paper was fed forward by an independent clockwork mechanism, the escapement of which was controlled by a cord, which, passing beneath the type-bars, received a pull whenever any of them was depressed, and allowed the train of clockwork to advance the paper the space required to emboss the next letter. Thus we have a third state in the evolution of the machine, namely, the equivalent of what we now call the universal bar."

SO once more we rise to bow in acknowledgment. In the past, as in the present and the future, we have not always been satisfied to serve merely as a chronicler of the advance of science. At times we have gone quite beyond the bounds of journalism and have taken a hand in the development of a given invention, either by contributing our ideas and suggestions to the workers in that particular field, or by conducting rigid investigations and studies which have resulted in helpful conclusions, we have every reason to believe.

FOR the present, our psychic investigation and our Abrams electronic reactions investigation are engaging our post-journalistic efforts, so to speak. In this issue will be found an interesting account of how Dr Geley, the well-known Director of the Institut Metapsychique International of Paris, obtained the famous Franek Kluski wax molds which have attracted so much attention in and out of psychic circles. The original manuscript, written by Dr Geley in French, his native tongue, has been translated by Mr Stanley de Brath, a well-known British engineer who has rendered into English such formidable works as Richet's "Thirty Years of Psychic Research." Mr de Brath has been a close student of psychic research, and our readers are assured of a translation that shall not suffer through any lack of special knowledge of the subject on the part of the translator. Numerous investigators have claimed to duplicate Geley's results, working with inflated rubber gloves. This

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NOVEMBER, 1923

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Vol. 129, No. 5. Published monthly Entered as second class matter, June 18, 1879 at the post office at New York, N Y, under the Act of March 3 1879

Price, 35 cents a copy $4.00 a year Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5 00 a year postage prepaid.

these have grossly failed to duplicate the severe test conditions prevailing during the production of the originals.

IN this issue, too, there appears the report of our first formal test of the Electronic Reactions of Abrams method of diagnosis. This first test was of the most elementary character, and we were prepared to follow it up immediately with others surrounded by more difficult conditions. Yet, singularly enough, the electronic reactions diagnostician in this instance, who claims to use the genuine Abrams methods and who certainly makes use of the Abrams "rate" charts and other Abrams technique, all but failed completely in his diagnosis of pure germ cultures. The report makes unusually interesting reading, but it is well to caution the reader that this test must not be considered conclusive. Far more work must yet be done before we can begin to formulate an opinion as regards the merits of the electronic reactions of Abrams diagnosis and treatment.

WE are fortunate in being able to present in this issue two articles on topics of the first importance, which have been written for us by two of the best-known Admirals of our Navy. They are timely, moreover, inasmuch as the anniversary of Theodore Roosevelt's birthday has been set apart this year as Navy Day, and everyone knows that the Navy has never possessed a stauncher and more helpful friend than the great man whom it thus honors. The tribute of Admiral Sims to Roosevelt's influence in building up the Navy both in its material and personnel, is particularly valuable because of the fact that the Admiral was Naval Aide to the President during the time when notable reforms in target practice ship design, and so forth, were made and he speaks with intimate knowledge of the facts. It is quite unnecessary to say anything here of Admiral Sims record. He was chosen to represent the Navy abroad during the World War, and the great services he rendered in this difficult position are a matter of record.

REAR ADMIRAL GLEAVES is another naval officer who stood out conspicuously because of his war services, for it was he who, with headquarters at Hoboken, had charge of the great and difficult task of putting two million of our American soldiers across the seas, and bringing them home again after the Armistice. There can be no finer tribute to the Admiral than the remarkably successful way in which this difficult work was done. The Admiral, as our readers will note, has a facile literary pen, and among his best works is a life of Captain Lawrence of the Chesapeake, which should be read by every student of American naval history.

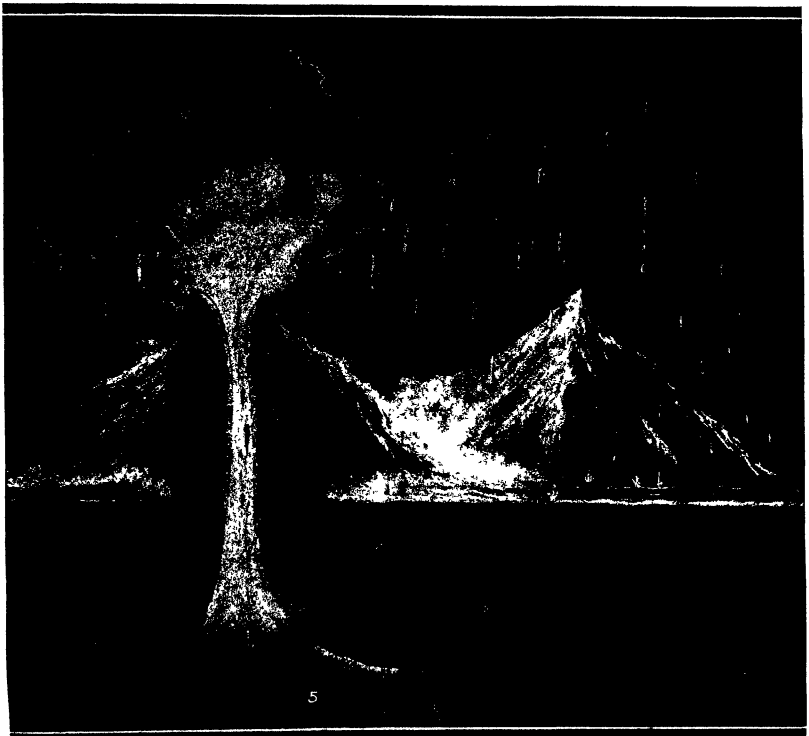
FROM Sir Oliver Lodge's own pen we learn something of the wonders of the atom, with the little universe of its own, in the article entitled "Within the Atom." Sir Oliver has the happy faculty of humanizing science. In this instance he takes the otherwise intricate subject of electrons and protons and converts it into a highly interesting story which may be read by layman and physicist alike. We hope to have other articles from the pen of this great scientist, who, contrary to the general rule knows how to express himself in a style that is as entertaining as it is understandable to everyone.

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, NOVEMBER, 1923



The mechanics of a volcano: The lava deposited by a former eruption is shown at (1), and the original strata at (2) Water sinking down to the fire reservoir (3) makes the steam of an eruption. (4) is rock which, although very hot, is not molten because of the pressure above it. At (5) the pressure has been released owing to the arching of the layer above, so the rock becomes molten, and out it spouts.—[See pages 304 and 305]

The Drama of Disputed Documents

Some of the Tests by Which the Expert Reveals the Forgery for What It Is

By Edward H. Smith

IN MAY, 1871, was begun, in the Court of Common Pleas of London, the greatest modern trial of a case involving falsifying and forgery The action had been brought for the purpose of dispossessing the trustees of Sir Alfred Tichborne, minor, in favor of the plaintiff, who proclaimed himself to be the long missing Roger Charles Doughty Tichborne and rightful heir to the large estates of "his" father The trial of this civil action and the resulting criminal prosecution of the claimant required all of three years, consumed enormous sums and brought the principals world-wide notoriety It put upon the musty court records of the day one of the strange and abiding romances of crime

Having been crossed in love through an unrequited passion for his cousin, the young heir to the baronetcy of Tichborne set out from England in 1853 for the antipodes. His ship, the "Bella," touched at Rio and put down to sea from there, to return no more Tichborne and all his mates of the voyage went down to the dark ports of the missing, and in due time the British courts in chancery determined his death and fixed the succession of the title and estates.

Only the young nobleman's mother clung with plaintive pertinacity to a belief, a hope, that he might have survived Seas and the fates of men are never too cruel for the wrung maternal heart Lady Tichborne continued to search for her lost son, mainly by asking acquaintances bound for Australia and New Zealand to seek for news of him In 1865 a man named Cubitt established a "Missing Friends Office" in Sydney and announced this fact in the London *Times* Cubitt soon heard from Lady Tichborne and undertook to find her son In the first months of 1866 she began to receive letters from a man who set himself up as the missing Roger and recited some of his adventures since leaving London in 1853. He told of the shipwreck, his providential rescue, his eventual arrival in Australia, his trials and his wanderings. And though he made many mistakes and palpable blunders, the bereaved mother declined to see any fault in him and accepted him unreservedly as her vanished son

In response to her urgings the Tichborne claimant went to London in 1866 and began preparing for an action against the trustees under the old baronet's will, made when the son was supposed to be dead He spent more than five years in these preparations, not beginning his suit until 1871 How he spent this time was developed at the two trials.

The claimant was in reality the son of a Wapping butcher, by name Arthur Orton He had gone to Australia the year after young Tichborne had set out on his fatal voyage In the antipodes Orton had suffered every manner of reverse and impoverishment Finally, more in jest than earnest he began to pass himself off as the Tichborne heir Later came the idea of making a grave pretension and trying to win the estate and title Orton was a gross-looking fellow of common education The man he was trying to impersonate was a British gentleman who had been primarily educated in France and knew his French better than his English

These heavy obstacles seemed not to daunt Orton at all He determined to make himself act, talk and write like a gentleman By some means he got hold of samples of the real Tichborne heir's handwriting and set himself the task of learning to imitate it His letters to Lady Tichborne reveal the extent of his success and the depth of his failure

After what must have been prodigious labor unrelenting discipline and unremitting devotion this common and practically unlettered fellow was able to reproduce the handwriting of a tenderly reared and over sensitive young lord with almost uncanny fidelity Orton got not only the obvious peculiarities of the Tichborne handwriting but managed by some strange adaptiveness of mentality to achieve what must be recognized as the nervous and psychological characteristics, a feat which handwriting technicians everywhere will recognize as next to impossible The false heir even learned to misspell just such words as the young baronet wrote amiss, because his principal education had been in French, no doubt. But what Arthur Orton, the cockney, could not do was to follow the phrasing characteristic of the man into whose life and identity he was trying to substitute himself Tichborne habitually thought in French and translated into English when writing letters, so that his epistles teemed with badly disguised French idioms. These were absent from the Orton letters and it was by this deficiency that the experts of that day fastened the fraud upon him

The man who conceived and very nearly carried to triumph this great impersonation, this astounding and impudent imposture, was eventually sent to prison as a fraud and forger Even after his conviction there were many thousands, among them persons who had known the young Tichborne well, who persisted in the belief that Orton was the true heir and a sorely wronged man Not until a good many years later, when poverty induced him to write his full confession for a London publication, was the doubt entirely cleared.

Enlarged typewritten words taken from an anonymous letter and juxtaposed to the same words written on the suspected typewriter Note the absolute uniformity

This world famous case may well serve as an introduction to the subject of the evergreen contest between the falsifiers of documents and the experts in questioned instruments of every kind, surely one of the most absorbing matches of wits between the man of society and the man of crime.

Falsification of various legal instruments is, of course, extremely old. Erasures have been found in the Nilotic papyri which apparently admit of no interpretation save that of fraud. The even earlier cuneiform writings on the clays of Babylon were so carefully protected by special clay envelopes, which would have had to be broken before the writing on the inner tablet could have been changed, and so elaborately provided with seals and the signatures of witnesses as to make it apparent that even the men who did the oldest writing ever discovered were cognizant of the forger and his methods. Classic and early Christian manuscripts, particularly those of a religious character, have notoriously been altered and defaced again and again.

Today fraud and falsification extend to every human article of value or interest Copied works of art, old palimpsests made to order, false signatures on pictures, fraudulent incunabula, forged autographs and spurious original manuscripts are being offered and sold every day Literary impostures are common as air, though the art has fallen upon evil ways since the day of Macpherson and his Ossian poems and Chatterton with his heartbreaking Rowley parchments, "recovered from the Redcliffe muniment chest"

Now, alas, no one bothers to palm off beautifully done verse as translations of Third Century Gaelic or the creation of a Fifteenth Century Monk. Indeed, the main trend of falsifying and forging runs afar from the shining and perilous fields of art. In consonance with the modern taste, it finds its way among the marts and places of business. As a result we have now more to do with false wills, bonds, legal conveyances and account books. An enormous total of money is got every year by such devices—tens of millions, past question. And were it not for the perfection to which the modern technician in authenticity has carried his work and his art, the loot of the forgers would assuredly be ten times as great. Here is where the modern contest begins between the expert in hand and typewriting and the criminal who makes this field the scene of his artifices.

The problem of instrument falsification and detection rests fundamentally upon four materials—paper, ink, removers and restorers. Typewriters, enlarging cameras, delicate instruments for measuring loops and pothooks, micrometers, straightedges, high powered microscopes, various chemicals used in analysis, reagents for testing the age of inked writing and much knowledge of inks, papers, writing machines, handwriting, characteristics, old manuscripts and the materials with which they were written are the secondary forces which figure in the matter

Ink is the stuff of prime interest. In former times all ink was gallate of iron, a substance which turned black slowly, after shorter or longer exposure to the air Gallate of iron is still the basis of all commercial inks now used in the United States, but today more and more auxiliary substances are being used in combination with the iron base, for the purpose of giving the writing an immediate "good color" What happens to the iron of the ink after some exposure to the air is exactly what befalls a steel blade when air and moisture strike it — oxidation. Weathering deposits a red oxide of iron on the steel It turns the gallate of iron into black oxide. Hence all iron inks turn blacker as they grow older, while the auxiliary colors gradually fade. There is, however, a limit upon the process of blackening. At the end of about eight years the oxidation is complete and no further change is observable.

This matter of the slow oxidation of commercial inks is the basis for one of the most interesting feats performed by the experts who use their science for the defeat of criminals. An ink-written document submitted to them any time under eight years can be chemically treated and the date at which it was written determined within very narrow limits. This bit of the expert's technique has been found of almost limitless usefulness in connection with the doctored books so often employed in bankruptcy cases. For instance.

Recently a firm of clothing merchants failed, owing its creditors a very large sum of money for goods purchased within a month or six weeks of the bankruptcy declaration. When the case was brought before the referee it was found that only one account book remained. It covered a period of about six months previous to the debacle. All the older records had, according to the claim of the bankrupts, been either accidentally destroyed or purposely discarded after the new set of accounts had been opened.

This single account book showed disbursements of various kinds, including the repayment of private loans, which brought the affairs of the concern to a seeming balance. In other words, the book version of the concern's affairs cleared the merchants of any appearance of fraud and showed forth evidence of the reason for failure The creditors, however, had good reason for believing that this book was doctored. The very fact that the older records could not be produced was considered ample ground for the suspicion that this one

account book had been speedily and fictively prepared, just before the breakup. Such practices are, of course, very common. They are one of the principal bases of the crime of fraudulent bankruptcy which, according to the National Association of Credit Men, costs the honest wholesalers and manufacturers of the country about 400 millions a year in losses.

There was added reason for suspicion in this sole book of accounts. It was to be noted that all the entries in it were written in the same ink and by the same hand. Moreover, there was so slight variation in the handwriting of the bookkeeper that the work had the appearance of having been written at one sitting, it being a well understood fact that no man or woman writes precisely alike at any two times. Mood, the state of health, the weather, the position while writing, the psychological state of the writer—all these vary constantly and affect the character of the writing slightly but obviously enough for the expert eye

But suspicions are of no account in court. Unless something more tangible could be developed, this book would have to stand before the referee and the claims of the bankrupts would likely be confirmed. The book was, accordingly, taken to that veteran examiner of questioned documents, Mr. David N Carvalho, who has been the chief American exponent of the art for fifty years and official expert of the district attorney's office for most of that long term of service. Mr Carvalho tested the ink on the first page of the book and the ink of the last He found that the oxidation had progressed almost equally in both samples. Also, he discovered from the degree of oxidation, that the writing had all been done within a period of ten or fifteen days and not more than 20 to 30 days before the bankruptcy Ergo, the entries had all been written at about the same time, they had not been made on the dates indicated and they were, therefore, fictitious. It was later discovered that the book had not been bought until several months after the date of the first entries. The fraud was thus established.

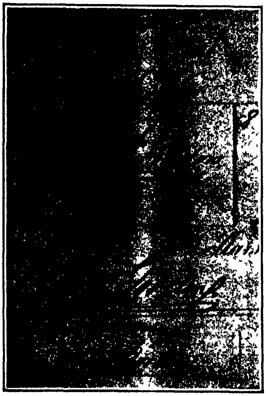
Falsified account books are coming to interest the handwriting technician more and more every year, as the practice of "doctoring" accounts and falsifying entries spreads over the country

The matter of ink removers is one I discussed some months ago in connection with check forgery and alteration It is as well, however, to repeat the fundamentals of the question here. All inks, being comparatively simple chemical compounds, may be broken down by chemical means. The exception is made of aniline inks, which have no known chemical affinities. These inks may, however, be instantly removed with a little water or a lick of the tongue. There are acid proof inks, and these have been largely advertised by the makers of check writing mechanisms. But it must be noted immediately that "acid proof" is a term of obfuscation and deception Such inks resist the common acids well enough, but they do not resist a combination of acid and alkali, which is what everyone uses as a remover Even the common ink remover which can be bought in any drug or stationery store makes swift mock of such pretentious combinations.

These commercial ink removers are, as everyone knows, contained in two little bottles and ordinarily labeled No. 1 and No. 2, indicating the order of their application No. 1 is usually a slightly red liquid, a 20 per cent solution of acetic acid. No 2, the white or clear liquid is a 10 per cent solution of chlorinate of lime or soda. The chlorinate, contacting with the acid, gives off chlorine gas, a very effective bleach of almost anything. This gas immediately changes the black oxide of iron in the ink into white oxide and the writing disappears, as the bleach also takes the other colors from the writing fluid. Expert forgers are acquainted, of course, with stronger removers than this, but the same principle underlies them all. The fact worth remembering is that nothing is actually removed by this process. The chemicals which give the ink its black color are simply whitened and made invisible. They remain in and on the paper Therefore, they can be restored.

The criminal, unless he is a man of technical education, usually fails to understand this and goes blithely ahead with his liquid deletives. Then his work comes under the eye of the expert. A simple and easy application of other chemicals, such as the hydro-sulfuret of ammonium, to mention only one, immediately brings the "removed" writing to sight—in deep yellow lines instead of black The white iron oxide has been converted into a sulfate and is as clearly legible as ever This test has often been made in court, in the presence of juries, with startling effect and usually sad results to the perpetrators of fraud

It frequently happens that men who plan frauds of this kind try to anticipate the expert by causing the original documents to be written in aniline inks, which are then removed with the tongue or a wet sponge Naturally, these inks and this form of removing leaves little or no trace and the writing cannot be restored chemically But the expert has still a method of circumventing the crook. All paper of modern type is calendered, which means that it is ironed or finished between hot rollers. If a drop of water or fluid chemical touches the paper thereafter, the ironed surface is disturbed and softened Even if a long period of time elapses, this blemish remains The expert finds erasures of this type by submitting the entire writing to the fumes of iodine. Wherever a paper has been so erased the iodine fumes cause it to turn blue and to begin to show the previously invisible pen wounds or cuts in the paper pulp. Such blue spots are then lightly dusted with lamp black and the original writing may then be clearly seen.



Genuine signatures of the late George P. Gordon, showing that he never wrote his name in the same size, that he used the pothook at the end only once and the scroll underneath when he thought of it

The last clause of the spurious will of George P. Gordon, showing the spurious signature with the pothook at the end and the uncertain, obviously copied scroll underneath

It must not be supposed that the criminal who falsifies handwriting confines himself to offenses against property Money, goods, wealth—these are, of course, the root of his motivation, but often enough the criminal must use murder as a weapon to his end. Most older readers will remember the celebrated Patrick murder trial and cannot have quite forgotten the great part played in it by the problems of forgery and handwriting.

According to the case laid down by the prosecution, Albert T Patrick, an inconspicuous New York lawyer, came to be slightly acquainted with William Marsh Rice, a multi-millionaire capitalist who had come from Texas, and conspired with Rice's valet, Jones, to draw a false will, execute some checks in Patrick's favor and write Patrick a number of letters, which could be produced to show that Rice and Patrick were intimate friends. Patrick knew enough to have the letters and the will written on a typewriter in Rice's apartment by Jones, who also did his master's secretarial work He then had Jones study Rice's handwriting so that he might be able to forge the old millionaire's signature to the various instruments.

Probably there was no original intention to murder Rice, who was 81 years old, very feeble and appeared likely to die at any moment But extraneous events forced the conspirators to desperate action The old man was first weakened with doses of mercurial pills and finally killed with chloroform, which was placed over his face in a towel cone while he slept

Jones, however, made two mistakes. In writing out one of the large checks made payable to Patrick he wrote the lawyer's name "Abert" instead of 'Albert" This blunder was found by the bank teller who refused to sign the check and tried to communicate with Rice. This slip caused the interruption of the plan for cremating the body and thus destroying the evidence of murder

The second mistake made by Jones is one common to forgers of signatures on wills and other instruments. Jones had evidently got one of Rice's genuine signatures and begun tracing it or copying it—probably the former He overlooked that fact that a man seldom writes his signature in precisely the same way and very rarely in the same size But all the signatures on the letters to Patrick, the checks, the request for the cremation and the will itself were of equal bigness and deadly similarity The forgery was apparent

Patrick was convicted on the strength of these handwriting revelations and the testimony of Jones, who became a state's witness. Patrick lay in the shadow of the electric chair for four years and was finally pardoned, largely because of the uncertainty of medical testimony

Typewriting presents special problems to the concealer and the expert Almost everyone knows, by this time, that writing machines have their individualities like human beings. No two machines, even though they be of the same make and model and operated by the same person, using similar ribbons and paper, will turn out work that does not show clear distinctions, one piece from the other Even if some of the type keys are changed after a fraudulent document has been written on a machine this fact can be developed and proved Or if all the keys are removed and new ones substituted throughout the expert is likely to find peculiarities due to the roller or some mechanical imperfection If he does this, he can also find out where the old keys were removed and the new substituted. Thus the only safety for the criminal is to break up the machine completely and dispose of it in some sure and secret way All these facts are more or less widely known among sharpers of every stripe

What is much less familiar to the public and the crook is the fact that typewriting has its nervous and psychological, as well as its physical peculiarities. The expert can tell whether a piece of typing has been done by a person who uses the "touch system" or the visual method, whether the writer uses two fingers or three or all, whether the writer is calm or excited and so on Each operator uses a machine a little differently, spaces individually uses various keys for special purposes, etc

Mr C D West, the veteran investigator of the National Association of Credit Men ran down one of the most celebrated of credit swindlers through peculiarities in typing. This man was in the habit of opening women's wear and specialty shops in various towns and

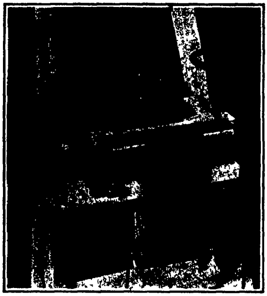
(Continued on page 360)

Earthquakes and Volcanoes

The Mechanics of These Titanic Subterranean Forces and Their Destructive Careers

By Edgar W. Woolard

Division of Seismological Investigations, U. S. Weather Bureau



Largest seismograph in this country, installed in New York City. This is a close-up view of one of the recording members

VOLCANOES and earthquakes afford spectacular and impressive manifestations of the titanic subterranean forces which are still at work on the fashioning of our globe; the cataclysms and upheavals accompanying their operations have occasioned the most terrible disasters which have befallen mankind. Catastrophe after catastrophe of this nature has marked the course of history, but never, perhaps, one so great as that which at noon on September 1 laid in ruins two of the principal cities of Japan and took a toll of about 200,000 lives. And as the Japanese people, like all peoples before them similarly stricken, turn quickly to the work of reconstruction, we wonder at the exhibition at once of man's feebleness and his greatness in the face of these appalling forces of nature.

Mastery over the effects of these natural forces comes only through a thorough understanding of their operations. Unfortunately, our views concerning the ultimate causes of volcanic and seismic phenomena are distinctly less confident than were those of previous generations. The "molten interior" of the earth and the dying "internal fires"—supposed heritages from that far-off age when the earth was born from the primal nebula—as the source of internal heat and of volcanic outbreaks have been banished from textbooks of geology, and their place has not been filled to complete satisfaction. Again, the simple conception of a cooling and therefore shrinking interior, overlain by a cold outer shell which becomes deeply wrinkled as the earth continues to contract, has been found inadequate fully to explain the origin of the forces which build mountains and cause the solid earth to tremble.

General Structure of the Earth

Several lines of evidence point to the fact that the earth is solid throughout, and about as rigid as steel. On the other hand, observations in mines and deep borings leave no doubt but that at comparatively moderate depths within the earth the temperature must exceed the melting points of all known substances. However, most substances, and probably all ordinary rocks, expand in passing from the solid to the liquid condition. For this reason liquefaction is opposed by pressure, and a much higher temperature is necessary to melt a rock subjected to great pressure. Hence the tremendous and ever increasing pressures within the earth keep the material in the solid state. At the same time, these very pressures soon exceed the crushing strength of any known substance. At a depth of from 12 to 15 miles the rocks must be reduced to a state where they *flow* under stress, like putty or tar, instead of fracturing or crumbling. In short, the pressures and temperatures within the earth reduce the rocks to a state like neither the solids nor the liquids with which we are familiar.

This part of the earth grades above into the outer brittle shell, where an increasing stress will in time result in the fracturing of the rock and the bodily displacement of blocks of the earth's crust along the break, or *fault*, as the geologist calls it. The stresses brought to bear upon the crust of the earth have been, and are still being, relieved by constant slow movements up and down, by warping, folding, faulting and dislocation, of the rocks of the crust, and by continual readjustments within the earth. Rock strata, the structure and contents of which prove them to have been originally horizontal sheets of sediments deposited at the bottom of the ocean, are now found at all elevations up to the tops of high mountains, sharply folded, and traversed by extensive faults, often hundreds of miles in length, along some of which thousands of feet of slipping has taken place. Great belts of weakness have been developed in the crust along which the major deformations have taken place.

Volcanic and Seismic Phenomena

Earthquakes and volcanoes are inevitable accompaniments of the above processes of earth deformation.

The immediate character of earthquakes has long been established as a form of undulatory motion in the more or less elastic rocky crust of the earth, originated by some sudden impulse or disturbance in the substance of the earth, much as a bowl of jelly might be set in vibration by a smart tap on the side of the vessel. In many cases, as in the California earthquake of 1906, the shock is accompanied by visible fractures and displacements of the solid rock, the disturbance reaches its climax close by the fracture. In other cases no actual faulting is visible at the surface, the whole of the slipping having taken place some miles below the surface. However, we have here only the beginning of the story, for we need to know what causes the fracture that gives rise to the quake, and this problem has not yet been fully solved.

Similarly the investigation of vulcanism has raised a wide range of problems, most of which still await solution. Just why volcanoes erupt, we do not know. The average density of lava differs little from that of the surface rocks, indicating that such material does not come from a great depth. If, in the various movements and deformations of the crust, the pressure should be relieved at some point within, melting would dubtless occur and a body of molten magma be formed, but no satisfactory reason for its ascension can be assigned. The generation of steam appears to have much to do with volcanic processes, and the fact that almost all active volcanoes are situated in, or relatively near, the sea, or near lakes, has led some to believe in a necessary connection between volcanic activity and surface waters. But it is now generally believed that the steam is generated from water or other materials which have always been present in the depths of the earth.

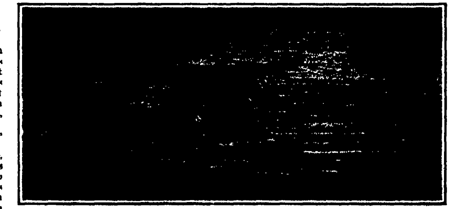
Earthquakes

The seismic regions of the earth are those in which extensive layers of rock of great thickness have been intensely folded, dislocated and elevated when the principal existing mountain chains were born. They occur in great bands, marking the lines of weakness in the crust, and generally following the lines of elevation which bound the huge oceanic basins—regions of recent, or in some cases still continuing, mountain growth. The rocks are held by friction and pressure under increasing stresses until they yield. Slipping suddenly, they communicate an elastic shock or jar to the crust of the earth, and vibrations spread out in all directions, with velocities of several miles per second. The vibratory motions, together with the sudden displacements and buckling of the ground, may cause general destruction over a wide area. Alarming sounds issue from the bowels of the earth, and if the quake occurs near or underneath the ocean, it is followed by a series of great sea waves (popularly misnamed "tidal waves") called *tsunamis* by the Japanese, which travel across the oceans at the rate of 300 to 500 miles an hour. A strong quake is invariably followed by a great number—usually hundreds—of weaker shocks.

Earthquakes are not always due to a single fracture or close-set group of fractures; they sometimes have very complex origins. Oldham has concluded that the faulting to which the destructive shocks are due is the secondary result of an extensive readjustment of some kind 50 to 300 miles below the surface. It is possible that minor factors may contribute to the determination of the exact moment at which a stress near the breaking point will be relieved by fracture; thus Omori has found an apparent connection between rainfall and earthquake frequency in northern Japan; and several investigators have found similar connections between earthquakes and barometric pressure: a quake may be set off by an additional weight of air and water on the land.

The permanent changes of position of the ground in violent quakes take place simultaneously in opposite directions on either side of the fault, and decrease in magnitude with increasing distance from the break until they cease to be measurable at a distance of several miles. The displacements, often amounting to 10 or 20 feet or more, may be horizontal, vertical, or both. This movement on opposite sides of the fracture in opposite directions is characteristic of the disruption of materials under stress, and quite in accord with dynamical principles.

When shocks are frequent and slight in a seismic region, the stress is constantly being relieved, and there is less danger of a heavy quake, where quiet has reigned for some time, the shock which eventually comes is likely to be severe.



Bird's-eye view of Japan, showing how the islands are formed by the tops of mountains which rise out of the sea

Earthquakes due to disturbances in connection with volcanic operations also occur, but, while often severe locally, seldom are noticeable more than a few miles from their origins. Tremors occasioned by the collapse of underground caverns are likewise local and unimportant. The tectonic quakes, however, i.e., those due to faulting of the rocks or to intermittent slipping along breaks already formed, may completely devastate hundreds of square miles of territory, and send vibrations through the entire globe.

The vibrations or elastic waves which spread out through the globe from the *focus*, or seat of initial disturbance, may be recorded by means of instruments known as seismographs. (The measurement of the great lurches of the ground near the origin of a violent quake is beyond the capacity of any instrument.) The general principle of all seismographs consists in having a heavy mass of metal arranged in the form of either a horizontal or an inverted pendulum, so that its inertia prevents it from partaking readily of the motion of the earth when the latter is shaken. A pen or stylus is so connected as to trace a record, greatly magnified, of the relative movement between the pendulum and the earth on a sheet of paper carried along by clockwork.

Two principal sets of earth vibrations are generated

during an earthquake. One set travels round the earth, in the crust, while the other goes through the interior of the earth, the latter set, again, is compounded of two species of vibrations superposed—one longitudinal (like sound waves in air), the other transverse (like light waves in the ether) The three kinds start out from the focus simultaneously, of course, but those which travel *through* the earth are registered first at a distant point, not only because they have not so far to travel, but also because they are propagated at a much greater speed. Furthermore, the longitudinal vibrations (*primary* waves, or first preliminaries, as they are called) travel faster than the transverse (*secondary* waves, or second preliminaries) Hence the three kinds of waves arrive at a distant point each at a different instant, and each traces waves of a different shape on the seismograph record.

A destructive quake is usually registered by seismographs all over the world, at a distant point, the seismograph often continues to record small vibrations for two or three hours. The study of the records of numerous quakes has made it possible, by noting the intervals between the arrival of the different types of waves, to draw curves showing the time taken by the various waves to travel given distances, and to construct tables from which the *distance* of the region lying above the focus (the *epicenter*) can be determined for any point at which a seismogram has been obtained. At most, only a guess can be made as to the actual *location* of the quake, however, unless the distances from *three* stations have been determined Then it is a simple problem to locate the quake exactly by drawing circles on a globe with these distances as radii and the stations as centers, and noting where the three circles intersect.

An earthquake is felt in some part of the world on an average of 4000 times yearly In the United States alone, a hundred or more occur each year Many tremors, occurring over small areas, are undoubtedly missed, and others, too faint to be sensible, are registered by the seismographs. Our globe is trembling somewhere practically all the time. Milne estimates the total annual output from all sources to be 60,000 quakes. Fortunately, the great majority of these are feeble and harmless, or else occur under the sea or in thinly populated districts. According to Milne, only 4151 *destructive* quakes occurred between 7 A. D and 1899

Japanese Earthquakes

The most unstable region of the earth at the present time is that along the western margin of the Pacific. It was in Japan, probably the most seismic region of the globe, that seismology as a science was born, about 40 years ago, through the pioneer work of the British scientists J Milne, J A. Ewing and T Gray. The earthquakes of the Japanese Empire have been studied more carefully than those of any other country

The Japanese islands are arranged in the form of a festoon, with its convexity facing the Pacific Ocean, and, as in similar groups of islands and in mountain-chains of the same form, the convex side slopes more steeply than the other The Japan Sea to the west is shallow, but on the Pacific side, between the Japan coast and the Kurile Islands, the ground plunges down into the great Tuscarora Deep to a depth of nearly 27,000 feet within 110 to 240 miles of the coast! The earthquakes of Japan follow a law which is general in such cases: they are most numerous and violent on this steep slope. During the 21 years 1885-1905, for every strong quake originating on the concave side of the islands, there were 16 on the Pacific side.

Earth tremors are a matter of daily routine for the Japanese people, 12,700 having been recorded in the ten years 1885-1894, while from 1902 to 1907 the average annual number was 1605. However, from 1601 to 1898, only 108 *destructive* quakes visited the country—one on an average of every 2¾ years—and only a few of these rank as outstanding disasters. The quake of 1703 is reported to have cost 200,000 lives. In the Mino-Owari disaster of 1891, 7000 perished.

Grievously as Japan has suffered from earthquakes and their effects in the past, the devastating shock of September 1 probably surpasses all previous disasters, although we have as yet only incompete reports and no scientific observations. The Osaka observatory places the epicenter in the Izu Peninsula The shock was violently destructive over an area extending 100 miles from north to south and 130 miles from east to west, and having a population of about 7,000,000.

Earthquake regions of the Western Hemisphere, shown in black

Other Great Earthquakes

Space will not permit of even an enumeration of all the great earthquakes of the past, but we may mention a few of the more notable Tremendous losses of life are reported in connection with some early quakes. Thus, in India, 1737, 300,000 are said to have perished, and again in 893 in India, 180 000 The greatest disaster of modern times, next to the present one, was the Messina-Reggio quake of 1908, with a loss of 100,000 lives. The most stupendous shocks on record are the Assam quake in India, 1897, destructive over 150,000 square miles and distinctly felt over one and three-quarter millions of square miles, and the Kansu quake in China, December, 1920. The former was not notably destructive of life and property, but in the latter the estimates of deaths run from 40,000 to 180,000, although as it occurred in a remote region, from which news was weeks in emanating it attracted little attention In the Sonora quake of 1887, felt over Mexico, Arizona, and New Mexico, an uplift of 20 feet occurred all along the base of a whole mountain range, but the region disturbed was only thinly inhabited The great Alaskan quake of 1899, in which vertical displacements of over 47 feet occurred, passed almost without notice for some time.

Active and recently active volcanoes of the world. The active volcanoes are shown as dots, while the recently extinct volcanoes are shown as crosses

Earthquake regions of the Eastern Hemisphere, shown in black

More famous are the Neapolitan quake of 1857, the extensive study of which by Robert Mallet was the first great scientific contribution to what is now the science of seismology, the Lisbon quake and sea wave of 1755, in which 40 000 perished, and the Avezzano shock of 1915, in Italy in which the ratio of deaths to population was the highest ever recorded, 97 per cent of the people of Capelle having been killed Chile is also noted for some disastrous quakes, the latest having been in November, 1922

A series of tremendous shocks rocked nearly the whole of the then settled portion of the United States for many months in 1811 13 The topographic effects of this New Madrid earthquake, as it has come to be called, are still plainly visible in the Mississippi valley, and aftershocks are still continuing The Charleston S C, quake of 1886 was relatively mild, but affected a very large area the San Francisco earthquake and fire of 1906 is notable for the great property damage, but the deaths were very few

The entire Fall Line of the Atlantic seaboard is a potential seat of earthquakes.

Prediction of Earthquakes

Possibly we shall some day be able to keep a record of the elastic vibrations of the earth s crust along danger lines, and thereby forecast a shock as we now do the coming storm But that ability if it come at all must await patient investigations over many years in the future

Geodetic surveys in California have indicated an apparent creep of the crust relative to the Sierra Nevadas, in certain regions of about three feet in ten years. Prof A. C Lawson of the University of California, considers this slow displacement to be a strain creep which accumulates until relief is effected by a sudden slip or a rupture, and he believes that it may some day be possible to predict about when the strains that are indicated by these movements will be released and cause a quake, Similar general indications may sometimes be obtained

On the basis of the number of quakes in the years immediately preceding, Omori in 1922 forecast the occurrence of severe shocks in Japan within six years. Similar general indications may some times be obtained from a study of the migration of epicenters in successive quakes along the seismic belts. A great quake relieves the stress in its neighborhood, and when next the stress finds relief it is likely to be at a more or less distant point along the belt This is illustrated by the series of shocks along the west coast of the American continent from 1899 to 1912, as follows Alaska, Sept 4 and 11, 1899, and Oct 9, 1900 Mexico, Guatemala, and other parts of Central America Jan 20, 1900 and April 19 and Sept 23, 1902, Panama, Colombia, and Ecuador, Jan 31, 1906 California, April 18, 1906, Valparaiso Chile Aug 17, 1906, Mexico, April 15, 1907 and Nov 19 1912

The most effective means of minimizing the danger from earthquakes is through exhaustive investigation of the location and activity of faults, and the study of the effects of earth shocks on buildings and structures, together with the creation of an enlightened public opinion by the wide dissemination of scientific information The element of danger will not then be grossly exaggerated by ignorance and negligence

Except where sea-waves and fire accompany the shocks, the loss of life is largely due to the shaking down of poorly constructed buildings. This can be prevented by a knowledge of proper materials and suitable types of construction Only in Japan, however, has such knowledge been extensively applied The native houses there are built to allow for earth tremors, being

(Continued on page 370)

Our Abrams Investigation—II

A Test to Determine the Accuracy of the Electronic Reactions Diagnosis

As reported by Austin C. Lescarboura

Managing Editor, SCIENTIFIC AMERICAN, Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

OUR FIRST test of the electronic reactions method of diagnosis took place on Saturday, September 15, in the laboratory of an Abrams practitioner in New York City At the invitation of this practitioner, whom we shall refer to as Dr X in the report which follows, we brought to his laboratory a number of vials containing pure germ cultures for the purpose of determining the accuracy and dispatch with which he could identify their contents. This seemed a simple yet convincing test, so we all agreed.

The laboratory, in this instance, is located on the ground floor of a typical high grade apartment house in one of New York's exclusive neighborhoods. It is here that Dr X carries on his diagnostic work, while in other rooms of the apartment he has a vast array of electrical and mechanical and luminous devices for the treatment of patients. The laboratory proper is by no means bare of apparatus, indeed, it fairly bristles with various devices and wires and lights. It might well be taken for an electrical or physical laboratory, rather than a doctor's consultation office First of all, there are large metal plates on the linoleum floor, then there are numerous bare and insulated wires about the room, also, there are colored lights to one side, which, we are told, have to do with a chromatic method of diagnosis which does not concern us in our present investigation, finally, there are several pieces of apparatus on the conventional white-topped table, which, at first glance resemble nothing so much as electrical measuring instruments or, better still, radio equipment.

But in spite of all this equipment the main element in the electronic reactions method of diagnosis is the human reagent. Dr Albert Abrams of San Francisco, the founder of this new medical cult which has attracted nation-wide attention, discovered a decade or so ago that the human body and blood had certain radio-active properties. Based on these early discoveries, Dr Abrams has worked out a method of diagnosis whereby a healthy human being is connected in a so-called electronic circuit with a sample of blood to be tested, and the indicative reactions are obtained from the human being, known as the 'reagent,' at the hands of the skilled Abrams diagnostician The reactions are generally detected by percussing certain portions of the reagent's body—the abdomen is the area usually selected, *although for specific diagnosis other areas are used.* Percussing is accomplished by passing the extended and rigid palm of the left hand over the abdomen of the reagent, and tapping the middle finger of the left hand with the middle finger of the right hand. The right hand finger is provided with an ordinary celluloid thimble filled with beeswax and small shot, so as to obtain better thumping of the left hand Normally, the percussing of the abdomen produces a characteristic hollow sound over an area which persists upward to a line on a level with the lower ribs. When the extended hand passes above this line, there is a decided change in the sound produced by percussing The hollow sound now becomes a dull thud The normal line of dullness having been determined, the reagent is marked with a black crayon to indicate the normal line.

So much for the normal reactions. When, however, the reagent is connected with the electronic circuit and a sample of blood or other representative matter from a patient and when the electronic circuit is adjusted for various 'rates' of vibration by means of a bank of switches the area of dullness either remains at the normal line or drops down some two inches.

Let us go through a typical diagnosis, so as to make the workings of this method sufficiently clear to go ahead with the business of our first test To begin with, the sample of blood or other matter is wiped, so to speak, with an ordinary horseshoe magnet, so as to eliminate extraneous electronic impressions It is logical to assume that any sample, in the course of ordinary handling, must pick up its due share of these electronic impressions which we are given to understand permeate everything and everywhere But why the electronic values of the patient, with all their delicate shadings and varying degrees of strength which go to make the diagnosis so critical as compared with orthodox medical practice, are not also wiped out or at least seriously impaired as the result of the magnetic wiping, we do *not profess to know We are still woefully ignorant on this point.*

At any rate, the extraneous electronic impressions are wiped out and the sample is placed in the so-called dynamizer, which has also been wiped with the hard-working horseshoe magnet in order to wipe out electronic impressions that may have stayed behind from previous samples. The dynamizer appears to be little more than a neat, round container, at the bottom of which are two electrodes whose ends are separated by a small air gap. These two electrodes are generally connected together and the single lead then goes to an amplifying device and to the array of other instruments. The dynamizer is provided with a close-fitting cap the under side of which has a metal plate connected with the other apparatus, consisting of multi-contact switches.

RESULTS OF THE ELECTRONIC REACTIONS DIAGNOSIS

The pure germ cultures used in this diagnostic test were as follows: Tube No 1—Typhoid. No 2—Pneumococcus No. 3—Colon Septecaemia. No 4—Tetanus. No. 5—Tuberculosis. No 6—Diphtheria. The tubes were handed to the electronic reactions diagnostician with labels carrying the corresponding numbers, and the findings in ohms are given below.

	No 1	*No 2*	*No 3*	*No 4*	*No 5*	*No 6*
Acquired Syphilis	26		66	..	.	
Congenital Syphilis	146	49	27	..	+	148
Tuberculosis	7	6	7	+	+	8
Gonorrheal Infection .	88	89	16	..	+	200+
Streptococcus (Pneumococcus) .	153		49	..	+	87
Malaria	59	17	17	39	+	28
Typhoid		.	.	..	..	..
Influenza	210+	36	46	22	+	..
Colon Septecaemia . . .		53	9	22	+	63
Diphtheria	Not tested.			3	Not tested.	
Tetanus	Not tested.			..	Not tested	

So far, so good The reagent, stripped from just below the waist, up, takes his place in front of the diagnostician, standing on a pair of grounded zinc plates. The diagnostician is ready to begin work. He determines the normal line of dullness, puts a mark on the reagent's abdomen, and adjusts the little switches of the diagnostic machine for the first "rate" of vibration, which is 55, designed to permit only acquired syphilis electrons, or whatever they may be, to filter through to the reagent

The diagnostician now percusses, and notes if the area of dullness has dropped down below normal If it has not, the patient is "clear" on that score. If it has, then he manipulates a second bank of switches in order to obtain a quantitative reading. The second bank, like the first, is arranged with switch points in suitable multiples representing ohms or resistance introduced into the electronic circuit. The diagnostician adjusts the switches of the second bank until the area of dullness in the reagent has receded back to normal, indicating that sufficient resistance has been introduced to choke off the flow of the electrons of that given "rate."

Thus the diagnostician obtains not only a "rate," which in this case is 55, which, according to the Abrams chart of "rates," represents acquired syphilis, but also a quantitative reading in ohms, such as 8 ohms, 6 ohms, 15 ohms, and so on The "ohms," of course, represent the degree of the ailment or affliction. We are told that the ohmage does not run uniform for different rates. Thus in tuberculosis 8 ohms is sufficiently serious to require treatment, while in malaria one can live quite comfortably with 17 ohms—the writer of these lines has been carrying 17 ohms of malaria—not to mention a nice array of other things with terrifying names and liberal ohmages—about for a long while back, without even suspecting the fact, until he was confronted with his electronic reactions diagnosis.

From "rate 55," the diagnostician goes to "rate 57," which represents congenital syphilis. If the reagent reacts to that rate, then the second bank of switches is manipulated to restore the normal line of dullness, and a reading in ohms is taken for congenital syphilis. And so the diagnostician goes down through a long list of "rates" which stand for as many ailments and diseases and afflictions. There is a set routine, of course, such as acquired syphilis, congenital syphilis, tuberculosis, gonorrhea, streptococcus, colon septecaemia, typhoid, malaria, influenza, and so on. Incidentally, we might mention in passing that lucky is the person who escapes without a trace or more of congenital syphilis in an electronic reactions diagnosis. Hence there need be no hard feelings we're all pretty much alike, electronically speaking.

The result of an electronic reactions diagnosis is a list of "rates," their corresponding medical terms, and their extent in ohms. Following such a diagnosis, the patient may be treated, if he so desires, and "cleared" of his various troubles. Some "rates" clear rapidly, while others require some length of time. When all the "rates" of a patient fail to give a reaction through the reagent, then that patient is considered cleared, or cured.

This method has to do with a diagnosis by proxy, so to say, in that the patient need not be present. There is no other feature of the Abrams teachings that is more spectacular—or more unbelievable Here we have a means of diagnosing a given case at a distance without the presence of the patient, indeed, someone has promised to diagnose Egyptian mummies in order to determine the diseases which prevailed in the distant past! Skilled Abrams practitioners will assure you that they can take a specimen of your handwriting and not only tell you all about your medical history—past, present and future—but also your racial strains, religion and other choice bits of private information

If the patient prefers, he can be examined directly, in which case he takes the place of the reagent and no sample of blood need be placed in the dynamizer

In the examination of the writer, he served as his own reagent and had his abdomen and other parts of the body percussed to determine the various "rates" and ohmages. Aside from percussing, there are other methods of detecting the reactions, such as the attraction and repulsion and sticking of electrified glass rods passed over the reagent's body, as well as the deflection of pith balls such as are used in the physics classroom In an early issue we shall have more to say about the apparatus or the mechanical side of this interesting subject

Coming back to Dr X and his laboratory, we start in with the reagent, whom we shall call "George" for short. George is a handsome lad of about 16 years of age. He has a remarkable physique, which was all the more in evidence when the editorial "we" disrobed sufficiently to serve as the reagent in a previous informal test. On the day of our present test George appeared to be in the pink of condition Dr X asked George if he had taken his usual quota of hot water, and upon receiving a negative reply he ordered George to do so. Then George did a few calisthenics—swinging his arms, working his legs, breathing deeply—just like a ring warrior getting ready for action.

Being curious as regards the mechanical side of this test, we studied the wiring of the plates which rested on the linoleum floor covering. They did not appear to be connected at first glance, and this aroused our suspicions. One of the grounding wires was traced to a water-pipe, which happened to be coated with paint Here, we thought, was a weak point; but further examination disclosed additional grounding wires running to steam pipes and making good "grounds." At any rate, we were entirely disarmed in this direction when George

proceeded to test the plates by means of a standard electric light connected to one side of the current supply and to a free lead, the latter being played on the zinc plates and producing sparks as the lamp blazed up. This satisfied us that the plates were really grounded, although seemingly George went about his work quite unaware of our suspicions and purely as a matter of routine. As a bit of stage effect, however, it was excellent, to say the least. Even our technical mind, well versed in electrical practice, was momentarily impressed with the logic of the thing

By now our committee was mobilized. For this test there were present an engineer, a bacteriologist of the Bureau of Laboratories, Department of Health, City of New York, and two members of the editorial staff of the SCIENTIFIC AMERICAN

For the first half hour Dr X and his assistant, a young lady whom we shall call Dr Y, engaged with us in an exceptionally interesting conversation The identity of the bacteriologist was not disclosed at this time Dr X told us of his interesting work as well as some of his extraordinary cases, the most startling of which was his recent treatment of a notorious character in New York medical circles known as "Typhoid Mary" This poor creature is a carrier of typhoid and has given New York no end of trouble Dr X told us how the health authorities, at his invitation, had sent the said "Typhoid Mary" to him for a test treatment. Despite the serious nature of "Typhoid Mary's' malady, not to forget several other serious ailments which the electronic reactions diagnosis disclosed, said "Typhoid Mary" was turned out in jig time, "cleared" of her ailments. This, obviously, was for us an astounding announcement—but only so until our bacteriologist spoke up, disclosing her identity and bringing forth the fact that she was quite familiar with this case. She assured Dr. X that if "Typhoid Mary' had been "cleared," she had not remained so. Parenthetically, we may mention in passing that we now have in hand the official record of her case, which shows that the claims of Dr X were not founded on fact.

During the discussion between Dr X and our bacteriologist, the latter brought out the point that a typhoid case runs in cycles, with a return to negative every so often Could Dr X have turned out "Typhoid Mary" at the low point in the typhoid cycle? We do not know

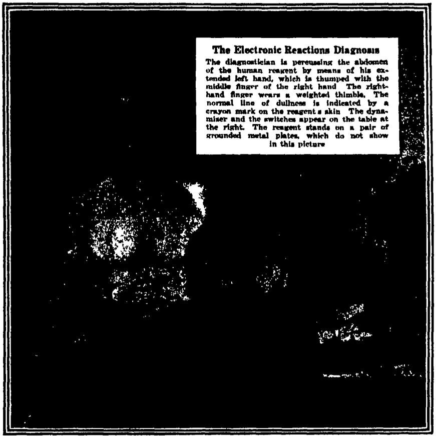
But to go on with our main business after the preliminaries which reminded us in no little degree of a psychic seance—this chatting about the marvelous things that are being done regularly as contrasted with the simple business in hand—the test proper got under way George took off his remaining upper garments and bared his husky chest and abdomen Dr X turned about in his chair, with his back toward us, facing George who stood on two ground plates. George put on the headgear and arm electrode. We were asked to ground ourselves, by taking hold of electrodes connected to ground wires. And then the first pure germ culture in its little vial carrying nothing more than a red-bordered label with a plain, handwritten numeral, was handed to the doctor One of our number who sat in one corner was asked to hand over the horseshoe magnet, kept at a considerable distance from the reagent.

At this point we are compelled to mention a slight inconsistency The magnet, we were told, must be kept at least eight feet away from the reagent in order not to interfere with the delicate reactions. On the other hand, Dr X pointed out to us the latest discovery of Dr Abrams, which takes the form of a horseshoe magnet suspended a few inches over the head of the reagent. The purpose of this magnet is to allow for a closer differentiation between "rates." Heretofore it has been difficult to split between "rates" with a clean-cut and positive reaction. Why one horseshoe magnet should interfere with the reactions at a distance of eight feet or less, and another magnet should prove advantageous at three inches distant, we do not know Furthermore, knowing how localized is the magnetic force of a small horseshoe magnet, we are struck with the extreme sensitiveness as well as inconsistency of the electronic reactions.

You have already learned from what has gone before that the electronic reactions practitioner goes from one "rate" to another "rate" in making his diagnosis. And in the event that the disease to be discovered is not included in his usual repertoire, he must needs continue his hunt after the manner of a search for the proverbial needle in the haystack. So, in order to save time and effort, Dr X suggested that we give him a general idea of what the cultures included. This was fair enough We did, cutting down the odds against the doctor

The lights were dimmed—electronic reactions must be carried out in a dimmed atmosphere, so as to have a minimum of light energy interfering with the delicate processes involved. Dr X began his search, percussing as he went from one rate" to another He announced his various findings from time to time The first tube turned out to be gonorrhea, according to the electronic reactions, but not according to our records. That was fair enough One specific answer for each riddle is the accepted procedure.

Then followed tube No 2, for which the reactions disclosed congenital syphilis—true to Abrams form, tuberculosis, colon septecaemia, streptococcus, malaria, flu—well, that is as far as we went with that tube Other "rates" would perhaps have given additional reactions,



The Electronic Reactions Diagnosis

The diagnostician is percussing the abdomen of the human reagent by means of his extended left hand, which is thumped with the middle finger of the right hand The right-hand finger wears a weighted thimble. The normal line of dullness is indicated by a crayon mark on the reagent's skin The dynamiser and the switches appear on the table at the right. The reagent stands on a pair of grounded metal plates, which do not show in this picture

but we had ample Needless to say we were keenly disappointed with such findings One specific answer should be sufficient Here was a veritable broadside, not necessarily aimed to hit something through mere chance, but certainly open to such suspicion

At this point Dr X began to display some concern over the results of our test Frankly, he agreed with us that pure germ cultures should be readily differentiated by means of his diagnosis, and that there should be but one answer for each tube The purity of the germ cultures was questioned, and their origin was clearly stated in refutation Some of the tubes contained 24-hour broth cultures, which had been transplanted from the pure stock of the Research Laboratories of the Department of Health, while others had been prepared by scraping the growth off slants of solid medium and emulsifying in sterile broth About three cubic centimeters of the culture was pipetted into a serum tube, which was then stoppered with a rubber stopper and sealed with paraffin Small labels with a narrow red border and bearing the number of the culture written by hand in blue ink, were pasted on the appropriate tube for identification purposes Dr X signified anxiety over the reagent It appears that George, robust as he is, becomes exhausted in an electronic reactions sense. George was asked to "short" himself, which he did by pointing his hands toward his side Normally, his hands are held down at his side, with palms facing forward and outward. George proved to be in the pink of electronic condition, for he brought his area of dullness right back to normal, even with conditions set for a strong reaction.

Then followed a talk about the super-sensitivity of the electronic reactions. Dr X brought out the point that the electronic reactions are far more delicate than anything now in the hands of the bacteriologist, including the ultra microscope Pure germ cultures may mean just that to the orthodox doctor and bacteriologist, but to the Abrams diagnostician there is evidently no such thing as a pure germ culture It was pointed out to us that the patient, from whom the germs were originally taken to be isolated and artificially propagated in the laboratory, was by no means an angel, and therefore had many of the ailments which afflict ordinary mortals. And now these ailments—or at least their electronic values—are carried right along with what is supposed to be an isolated culture Further, these electronic values grow in power with age—perhaps one ohm a year would be about right, although this phase has never been looked into by the Abrams investigators, so we were told Hence such a test as we endeavored to make was hardly fair, so Dr X assured us.

A third tube was tested Acquired syphilis, congenital syphilis, tuberculosis (slightest trace), gonorrhea, colon septecaemia malaria and flu, but no streptococcus, was the verdict. Another broadside!

Well, it was evident by now that the electronic reactions were not proving their case So the writer suggested that, inasmuch as we were dealing with pure germ cultures, surely these cultures should be preponderant in one "rate' as compared with the other "rates" which were due to traces of by-gone associations

Dr X thought this idea capital and we began to test the pure germ cultures on the basis of ohms instead of the plain qualitative analysis as heretofore The results are indicated in the accompanying table which presents a ready means of comparing the electronic reactions diagnosis with the actual contents of the pure germ culture vials A study of this table will immediately disclose that here again the electronic reactions did not meet with success. Instead of obtaining one preponderant ohmage for each tube, which would indicate the pure germ culture content, Dr X obtained numerous high readings so that the identity of each tube failed to be made out Broadside upon broadside!

By now, things were not happy with the doctor He fully realized that simple as our test was, it could not be successfully met So he sought some reason for his flat failure He asked to look at one of the pure germ culture vials Looking at it in full light, presumably for the first time he discovered the red edge on the label as well as the blue handwriting

Right then and there Dr X found the reason for his unsuccessful diagnosis. He explained to us that red is fatal to the accuracy of the electronic reactions! The presence of that bit of red on each label was sufficient to upset the reactions completely And by way of bringing out his statement he told us that several days previous he had been working one entire morning with George, and had been obtaining very unsatisfactory results. Finally toward the end of that morning's session he asked George if he had anything about his pockets. A search disclosed a bit of red cardboard—the seat check of a theatre ticket!

Furthermore there was handwriting on our labels. No doubt the electronic emissions from the writer of those labels were being carried along in the diagnosis. If so, the writer of those labels must have been in a terrible state of health—and mind, so we reflected at the time Again, the labels were of the gummed variety, and might have been licked, continued Dr X Here our bacteriologist spoke up rather indignantly and said that one of the first things a bacteriologist is taught is not to lick labels A rather unhealthy practice, it would be, with so many choice bacteria about!

Well, this matter of labels had to be taken care of if our test was to proceed So a member of our committee went into the doctor's office and wrote a set of plain

(Continued on page 370)

Within the Atom

At the Very Foundation of Matter with the Electrons and Protons

By Sir Oliver Lodge

WE HAVE gradually learnt that electricity exists in two forms, the negative form, which is called an electron, and the positive form, which is now beginning to be called a proton There is no other kind of electricity so far as we know The material universe seems to be built of these two elements Both the electron and the proton are exceedingly small very much smaller than an atom of matter Both probably have weight, though one is much heavier than the other The proton weighs as much as 1830 electrons. But it is not appreciably bigger, and some even think that it may be smaller than an electron The fact is, we do not know very much about it, except that it is the unit of positive electricity, just as an electron is the unit of negative electricity Whether the proton is an ultimate unit or whether it can be resolved into a close-packed assemblage of simpler ingredients, which would account for its remarkable weight or massiveness, remains for future discovery It may have a complicated structure for all we know but at present it seems to us one and indivisible So does the electron

FORTUNATE indeed is the SCIENTIFIC AMERICAN in being able to present to its readers an interesting, popular article on the structure of the atom, written by the eminent British scientist, Sir Oliver Lodge By common consent the author of this exposition stands as the dean of all living physicists His lifelong researches in an attempt to ascertain a knowledge of the ultimate nature of matter, energy and life, the three elements that are commonly believed to make up our Universe, have been crowned, mainly, with success. We cannot "see" the atom, much less the electron, but the physicist has been able to devise instruments that nevertheless enable us to appreciate them with our weak senses, of which these instruments become, as it were, powerful extensions.

Parenthetically, we may say that both are hypothetically supposed to be probably built up in an unknown way out of the ether of space, so that they need not be foreign bodies in the ether, but a specifically organized portion of it But all this is at present hypothetical and need not be emphasized Suffice it for present purposes to say that both electron and proton certainly exist and almost as certainly that they constitute the apparently indivisible elements of which all matter is composed

They are, however, both closely related to the ether somehow, for they attract and repel each other That is to say, there is a strong mutual force urging electrons and protons together, and at the same time keeping apart the units of the same kind, and this force, whether of attraction or repulsion must necessarily be exerted through and by means of the intervening ether Furthermore, we know that when either is in motion it is surrounded by a magnetic field, which magnetic field consists of some modification in the ether, and extends a considerable distance round the moving nucleus or kernel. These facts are commonly expressed by saying that a moving charge has two fields of force, one, radiating from it in all directions, is called its electric field while the other, which surrounds its line of motion in rings—opening out more and more of them and crowding them closer together as the motion increases in speed—is called its magnetic field It is this last which confers upon each unit its fundamental property of inertia, that is, its power of persisting in motion until it is disturbed—checked, hastened or deflected—by some external force

The size of these electric units is now known with fair accuracy But about their shape nothing is known It is natural to think of them as spheres, but there is no evidence for that shape and no reason can be given why they should have that shape The spherical shape is characteristic of large masses of matter, such as suns and planets, and for good reason A large enough body must be spherical otherwise it is unstable A great mass of matter of irregular shape or even of regular shape, like a cube or a cylinder or an elongated oval, could not remain in that condition Its protruding portions would be pulled down and merged in the rest by gravitative attraction But no such force acts effectively on a small body It is too insignificant in amount to be effective Accordingly, the shape of a small body has to be ascertained by observation It may be like a marble, but it might equally well be like a ring, or a sixpence, or a corkscrew Or again it might be shaped like a feather, a seed, or a tadpole. We assume that every proton is like every other, and that all electrons are alike, too But we do not know even that for certain. Meanwhile, it is natural and simple to think of them as little spheres, always bearing in mind that there is no evidence for that assumption, and no evidence against it

We know so much about these units now that it is well to remember from time to time the points about which we are still ignorant. We know approximately their bulk and their mass, or what is commonly called weight But of their shape, structure and constitution we are ignorant We know that a proton weighs just about the same as one atom of hydrogen, but that it is in bulk a million million times smaller We know that an electron is comparable in size to a proton, but is 1830 times lighter or less massive This 1830 is an experimental number and does not pretend to be quite accurate It may turn out to be as small as 1820, or as large as 1860. But the best measurements lie between these two extremes, and 1835 is a very reasonable value, according to our present information This may seem unimportant, but I mention it as showing how precise our knowledge about these things is gradually becoming

In the same spirit I can say that the diameter of an electron has been measured as $37\frac{1}{2}$ times the hundred-million millionth of a centimeter And that the weight of an atom of hydrogen, with which we have above compared it, is 1.66 times the weight of a milligram divided by one followed by twenty-one 0's. That is to say, that an atom of hydrogen weighs a million million million times less than a minute visible speck, such as a granule of lycopodium, which is about as small as can be weighed on a very delicate chemical balance.

A special fact may here be mentioned, as testifying to the correctness of our knowledge as far as it goes. An electron has a certain exceedingly small mass or weight, but when it is moving very fast—much faster than anything we ordinarily know of—this mass or weight ought, on electrical principles, to increase, by an amount which can be predicted. Such an increase was, in fact, predicted, and its amount calculated at various high speeds short of the speed of light Experiment subsequently became possible, with the particles shot off by radioactive substances, and when the mass or weight of these violently flying particles was measured, and compared with the theory relating to the increase expected, the calculated and observed values were found to agree exactly These scientific predictions, and their confirmations, ought to be better known and understood by the world at large

EVERYONE is familiar, at least with the words "electron", "proton" and "nucleus", but many have experienced some difficulty in getting an unconfused, clean-cut conception of the beliefs at present held by the majority of scientists concerning the various inter-relations of these components of the atom In the accompanying article the distinguished author demonstrates a faculty which, on the part of the higher scientist, is rare—that of putting himself in the place of the more or less popular reader of science and making his phraseology and style plain, simple and free from the puzzling technicalities that, while A-B-C to himself, cannot with comfort be followed by the average reader.

The increase of mass with speed is consistent with Relativity doctrines, but it was fully known before that. Only, now we feel pretty confident that the same thing applies to all matter, and that matter is therefore electrically constituted

That these minute corpuscles can build up gigantic bodies such as the earth, the planets, the sun and the stars is astonishing—like most other things in the universe when we dive down into them But yet it seems an undoubted fact for which the evidence is exceedingly strong, so strong as to be practically conclusive It has long been known and admitted that these great bodies are built up of atoms, and now we have learnt that the atoms are themselves built up of electrons and protons. And we have begun to learn what is the structure of an atom, that is to say, how it is built up out of its constituent elements—the opposite units of electric charge. We are now, however, entering on a region where some debate is permissible and some differences of enlightened opinion may exist. But the hypothesis which holds the field, and the one on which Rutherford and Bohr and others are working, is that the atom is built up on the general pattern of a solar system That is to say, that it consists of bodies arranged like the sun and planets, on a very minute scale First of all we find a group of protons in the center, half of them presumably welded together by a compact and interleaved assemblage of electrons, which are also able to hold on the other half of the protons as part of the compact group. This central group represents the sun, and outside it, and at some distance from it, we find a regular series of electrons revolving round it, either singly or in rings, like the planets, or possibly in some cases, though less likely, like the Ring of Saturn

Furthermore, it has been found possible to count the outstanding or unneutralized protons and electrons in atoms of different kinds.

By "atoms of different kinds" I mean the chemical elements, iron, lead, zinc, carbon, oxygen, hydrogen, sulfur, gold and radium and all the eighty-three other elements of which the world is composed. There seems no doubt about this counting, though it is a remarkable achievement. It is the result of work done by several living men, such as Rutherford and Barkla, and especially by young Moseley, who was killed by a Turkish bullet shot through his brain at Gallipoli—a remarkable testimony to the efficacy of war in settling human affairs.

The number of unneutralized protons at the center, and the number of planetary or revolving electrons in any given atom in its normal state, must be the same. Many or few, there must be the same number of each, otherwise the atom would be electrically charged, and would not be in its norma condition. One electron too many would yield a negatively charged atom, two electrons too many would be doubly charged, and a few atoms might be even triply or quadruply charged. But such charging must be considered exceptional and not likely to be permanent, for these additional electrons would be hanging on in the teeth of some repulsion and would soon be likely to escape

On the other hand, a deficiency of one or two electrons in an atom would mean that it was positively charged, and that, too, would be an unstable and exceptional condition For the electrical force exerted by such an atom would be very great and would soon be able to collect stray electrons and thereby restore the balance to equilibrium. When the charge of an atom is unbalanced or not neutralized the atom is readily guided and propelled and, as an easy traveler, is called an "ion."

It is not to be supposed that the protons and electrons here spoken of as contributing to the central positive charge and the equal peripheral negative charges are all the protons and electrons that exist in the atom, the nucleus may contain many more, and in fact usually does contain about double that number Those of which we here speak are the most prominent, the most efficacious and, in fact, are those upon which the chemical properties of the element depend. The others, tight packed in the nucleus, contribute to the weight of the atom, but do not contribute to its chemical nor to its radiative properties. They are more like an inert mass of satisfied material upon which the other more active and demonstrative units are grafted. The compact central mass does not contribute to its electrical behavior, which is the most conspicuous phenomenon in an atom, whether it be regarded from the physical or chemical side; they con-

tribute only to its weight and inertia and mechanical properties generally.

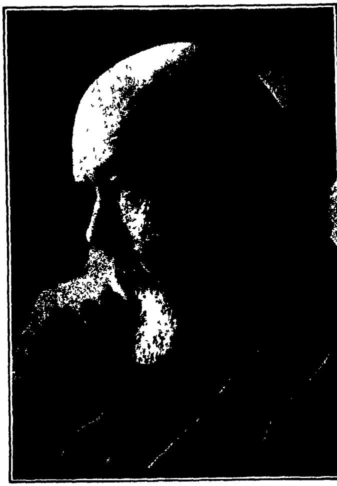
Consequently, the inert part of the central mass is often ignored, and seemed to be of minor importance until some means was found for breaking it up. Attention was and is concentrated chiefly upon the outlying negative electrons and upon the corresponding number of protons which by their electrical attraction hold them together into a sort of solar system These are what have been counted, and these are what are chiefly important to our present knowledge. But the others do not escape detection, and it is easy to count them, too—in fact, quite easy, for they are responsible for the atomic weight and are at once determined by the weight of the atom Given that an atom of hydrogen contains one proton, and weighs one, then an atom with atomic weight 16 must contain 16 protons. But not all these are active, only 8 of them exhibit electrical forces and hold 8 electrons in orbital movement The other 8 constitute the rest of the nucleus and represent its electrically neutral portion.

So also with an element of atomic weight say 31 Sixteen of them are inert and 15 of them are electrically active. The active number are what determine its chemical and spectral behavior, and it is known as the atomic number of the element Roughly, it is usually about half the total number, sometimes exactly half, though in all cases rather smaller than half when not exact.

Anyone can tell how many protons altogether there are in an atom Simply the number expressing its atomic weight on the scale in which oxygen = 16. The interesting thing is how many of these are chemically or electrically active, and this is given by what is called the atomic number Of this number there can be no fraction, and it proceeds regularly through the different elements from 1 to 92. Nearly all these 92 elements are known—there are only three or four gaps—and any day the few outstanding gaps may be filled by the active and enlightened investigators of the present day

If we now ask how many electrically active protons, and how many electrically active electrons, go to make an atom of sodium, the answer is forthcoming. The number is 11 of each If we ask the same question about chlorine, the number is 17 of each If we ask it about carbon, the answer is that six of each kind of electric charge constitute the effective part of the atom of carbon If, however, we proceed to some of the heavier elements and ask the question about lead, the answer is the suprising number of 82 of each kind. If we inquire into the constitution of radium we find 88 of each kind, 88 active protons along with 137 of the inert or satisfied variety exist at the center, and 88 planetary electrons, either revolving or else grouped in some pattern, are attendant round the central nucleus or sun The heaviest known element is uranium, and for that the number is 92. No element with a greater number than that is at present known Possibly any greater number would be too unstable to exist for any length of time, so that it would be extremely rare. Even uranium is not quite stable and if we were to watch an atom of uranium for a sufficient length of time—which would be a very tedious business, for we might have to wait a thousand years—we should see (that is, mentally "see," for, of course, an atom is hopelessly invisible) a group of four protons violently escaping, and we should see electrons escaping too, two packed up with the proton group and two thrown off separately, showing that of the four protons two came from the inert portion of the nucleus and two from the electrically active portion, so that the projectile retains a double, not a quadruple, electric charge. The number remaining of the active variety of each would thereby be reduced to 90, which would mean that it was no longer uranium, but another element called uranium X. And this also would explode or fire off a particle in time, so that the number would then be reduced to 88, when the main or residual substance would be radium Then it might go on with rather increased activity, though still only very occasionally as far as each atom was concerned, until the number got down to 82, with two well marked intermediate stages, one of them called by Madame Curie polonium The element with 82 active pairs would be fairly or perhaps quite stable and would be indistinguishable from lead. If the number ever got down to 80 it would be mercury And at 79 (though that is not in the true line of descent) it would be gold.

So much for the heavier, unstable end. But what about the lighter elements? Carbon, for instance, has only six pairs, oxygen has eight, nitrogen seven, lithium has only three. Helium, that comparatively rare, inert gas, found by Sir William Ramsay to be given off by certain minerals and by the hot springs at Bath and other places (given off also during the disintegration of radium), an element first discovered spectroscopically by Norman Lockyer in the sun and hence called helium, or "helion," as we now see that it ought to be called, has only two But the first known of the inert gases, the one discovered by Lord Rayleigh, viz., argon, has eighteen The helion atom has the atomic weight 4 So it must contain four protons in all and, of course, also four electrons. Two of these seem more closely imbedded in the structure than the other two, but all of them are so tightly held that the atom has very little external field and accordingly is chemically inert—so inert that the atoms are unable physically to hold together by cohesion. Therefore it exists as a gas consisting of isolated atoms. The smallest jostle or provocation will separate such atoms from each other and, accordingly, it can be liquefied only at an exceedingly low temperature, very close to absolute zero For at that low temperature the jostling practically ceases and the atoms are so nearly quiescent that the bonds of their feeble residual affinity are not broken.



Sir Oliver Lodge, Principal of the University of Birmingham and leader in research on the nature of the atom

The atom of helium is very like one of those projectiles flung off by a radioactive substance and called an alpha particle, but whereas an atom of helium is electrically neutral an alpha particle is by no means neutral It has a double positive charge and it needs two electrons to satisfy it But these it soon picks up, and then it becomes the completely satisfied and inert atom of helion. The 4+2 have become 4+4

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Is there any element that has only one constituent pair, one proton as the central nucleus and one revolving satellite, like an earth moon system? Yes, the answer is definite and certain The lightest known element is hydrogen and hydrogen has only one of each The hydrogen atom is constructed on the pattern of the earth and moon

Thus there are exactly ninety two elements and no more One cannot imagine an element lighter than hydrogen, unless it is possible to split a proton and an electron into fractions. It is easy to imagine an element heavier than uranium, or any number of them. Hence, in that sense, there may be more than ninety-two, but not by interpolation, only by extension of the heavy end. And although such elements have been looked for—notably an inert gas with the atomic number 118, which might possibly have been expected—none of them has as yet been discovered. The evidence on the whole is against their probable or frequent existence However, the possibility of building up still more complex and probably still more unstable elements, under special conditions of temperature and pressure, remains a subject for future discovery

The building up process we have not learnt how to accomplish, nor have we ever observed it going on. The tumbling down or disintegration process we have observed it constitutes the phenomenon called radioactivity But even that we are unable to control It goes on spontaneously or not at all Nevertheless, it goes on with great violence The atoms really do explode, as a cannon explodes, firing off a shot with great vehemence at a speed of several thousand miles a second.

And the nature of this shot has been analyzed We might have expected it to be a proton But, strangely enough, it is not As stated above, it is a group of four protons, welded together by two electrons, all apparently jammed together into a compact mass, without any satellites or revolving charges. The projectile really is a projectile weighing four times as much as an atom of hydrogen. And, moreover, it is not in a permanently stable condition It seems stable enough mechanically but not electrically It has four positive charges and only two negatives. Consequently it is electrically unbalanced It has a double positive charge

A projectile of that kind, moving at that tremendous speed, is quite a serious thing and can do a lot of work before it is stopped If it hits a phosphorescent substance it emits a flash of light If it strikes another atom it might do some damage.

But if an atom is like a solar system, we might well ask, "What is there to strike?" Will it not rather go through an atom? Certainly, that is what is to be expected, and that is what happens. Atoms are exceedingly porous, just as porous as a solar system, so that a projectile going through them is quite unlikely to hit anything But every now and then it may and sooner or later it must, on the doctrine of chances It may go through ten thousand atoms without hitting anything. But if ten thousand projectiles were loosed through the solar system at such speed that gravitation had no appreciable effect, one of them at least might hit the sun, and then something would happen

Sir Ernest Rutherford has tried the experiment with nitrogen He has got one of the radioactive materials, offsprings of radium, to fire its projectiles through nitrogen gas. Thousands of them hit nothing or encounter only one of the electrons, which they may be able to sweep up and carry away without much disturbance, for an electron is such a light thing But occasionally they may hit the nucleus. And the nucleus of nitrogen is fourteen times as heavy as hydrogen, while the projectile is four times as heavy Hence the encounter is no trifle The experiment is like firing a crowd of suns, each a quarter the weight of our sun through the solar system Many go through free and go on, some might sweep up and carry away one or other of the seven planets. But one by chance encounters the sun itself There is a smash and the sun breaks up The atom of nitrogen is disintegrated, not by spontaneous radioactivity and by its own energy, but as by the explosion of a shell or the impact of a violent projectile

And what happens to it? Is it dispersed into its constituent protons, or do some of them hang together still? The answer can only be given by experiment The answer found by Rutherford is something like this that most of them hang together in groups, constituting three atoms of helion, while two odd ones are flung out with great speed—even greater than that of the projectile which drove them—so that we get violently ejected atoms of hydrogen.

It is as if the atom of nitrogen were really composed of three helion and two hydrogen atoms—as if it were a compound of those primary elements and that it was disintegrated or broken up into its constituents by the impact of an alpha particle

(Continued on page 372)

Our Point of View

Navy Day

BECAUSE of the inevitable decline of interest in the Army and Navy which manifests itself at the close of a great war, the setting apart of one day of the year as Navy Day, on which the country is asked to give thoughtful attention to naval affairs, is altogether commendable

Speaking in favor of the institution of Navy Day, and having in mind no doubt the pernicious propaganda which aims at the immediate abolition of all armaments, President Coolidge recently said "Our country has undertaken as its proper contribution to ameliorating the burdens of armament in the world, to place certain strict limits on our naval establishment. In view of these, it becomes desirable that the highest efficiency in men and material be maintained." To the same purpose, Acting Secretary Theodore Roosevelt reminds us that "behind the protection of the Navy our people are able to carry on their lives, develop their ideals and live in the righteous peace we so earnestly desire It is the right arm of our State Department"

Of the misleading statements made by those who would emasculate, if not altogether destroy, our Navy none is more false and unjust than that which describes the Navy as a symbol of war and its officers and men as the advocates of war As a matter of fact, from admiral down to enlisted man, there are no citizens who are more united in the earnest desire for peace They know what war means. President Kelly of the Navy League is well within the truth when he states that no men are more truly pacific than our Army and Navy men—"our own brothers and sons, who realize more keenly than others the horrors of war, and seek only the strength that will maintain peace—the peace of honor and justice which is the only peace America should ever tolerate"

When the history of the stupendous events of the war and the post war period comes to be written and they can be judged in their true proportion, we believe that the gathering around the table of the five leading naval powers at Washington to frame the Treaty of Limitation, will be recognized as perhaps the greatest single contribution of the United States to the permanent peace of mankind That treaty has now been ratified by all the powers concerned, and they, with us, are at present engaged in breaking up the superfluous material of over-developed navies.

Let no one regret this destruction, for this superfluous armament was the child of suspicion, fear and international hatred The fleets as reduced by the treaty are no more nor less than the international police of the high seas. It is the duty of the American people to maintain its present Navy, which is preeminently a preserver of the peace, at its highest possible level of efficiency, and give to it at all times loyal and patriotic support.

"ZR-1" Sails Over New York

OUR FIRST sight of "ZR-1" was from the observation platform of the Woolworth Tower, as she reached New York City exactly at the hour predicted. It was in mid-September, and a faint haze, suggestive of Indian Summer days to come later, softened the outlines of the city below. Precisely at 11.30, out of the air came the distant drone of the airship's motors, and lo! above the Statue of Liberty there became visible through the haze what looked for all the world like a gigantic silver bubble, which grew in size until the great ship swung to port and revealed the whole 680 feet of her truly beautiful form to view With her six motors throttled down to half speed and the national flag snapping at her stern, she swept majestically by as she laid her course up the Hudson River

Apart from the beauty of the spectacle (and a silver-tinted dirigible, when seen under such conditions, is an undeniable object of beauty) the most striking impression was that of the stability and perfect control of the vast ship, which, be it remembered, in spite of the light and fragile materials of its construction, weighs no less than thirty-seven American tons. Throughout her journeyings up and down the length of Manhattan Island she traveled for the most part on a level keel Occasionally, vertical and horizontal changes were made under an easy helm and very gradually Evidently, in these early trials her commander is not going to subject "ZR-1" to the severe bending stresses, due to a sudden and extreme shift of the helm, which crumpled up the girders of "ZR-2" and brought about the fatal disaster at Hull, England.

During her last run, before heading for Philadelphia and home, she passed directly over the Woolworth Tower twice as far above our vantage point as we were above the street below To stand on a man-made structure that soared 750 feet above the earth and watch that huge fabric, big in bulk as the tower itself, sweeping majestically across the heavens was a sensation indeed! Here were the dreams of the builders of Babel and of Dædalus himself come true!

The primary purpose for which the Navy has built this ship is to act as a scout for the Atlantic fleet—a work for which her great speed and large radius of action render her preeminently suited Some day in the future we shall have a squadron of such ships to act as the farseeing eyes of our battleship fleet Scouting abreast, in a line flung wide across the Atlantic and in radio touch with each other and with the commander-in-chief, they will render impossible any surprise attack upon our shores.

It is no empty boast to claim that "ZR-1" is the finest airship of the rigid, or of any other, type that has ever been built. For so she should be, since within her has been incorporated all the experience of the Germans, who originated the Zeppelin, and of the British, who carried on dirigible construction in the years succeeding the war and made a successful round voyage from England to America and back

But over and above this, the new design has engaged the best talent of our very able corps of naval constructors. Not only have the stresses (far more complicated in a ship of the air than in a ship of the sea) been made the subject of exhaustive study, but every member that was built into the framework was first tested in the naval aircraft factory at Philadelphia. Finally, and greatest surety of all, the use of the ever-dangerous hydrogen has been abandoned and "ZR-1" is filled solely with non-explosive helium. Hence she is the first ship to be rendered immune to the flaming bullets of attacking airplanes.

Pandora's Chest Modernized

OUR FAMILIARITY with the wonders of radio broadcasting may not exactly breed contempt, but at least it takes away from the romance of the thing. As a fairy tale, radio broadcasting would fare quite well; indeed, the present-day receiving set in the home, bringing to the household the music and news and talks from the four corners of the globe, might well fill the rôle of the famed Pandora's chest with its never-ending flow of beautiful contents. As a reality, however, radio loses its romance as it gains in practicability and popularity. But, then, this is a practical age!

Pandora's chest—that is the keynote of radio development today When radio first came into the household as the result of broadcasting, it had a distinct laboratory touch. There were numerous handles to adjust, storage batteries to recharge, dry batteries and connections to watch after and a maze of wires connecting the various scattered components. Frankly, as a living room furnishing the radio set was designed to upset the best of decorative schemes, and more than one fastidious housewife stood firm against such invasion and insisted that the radio set stay in some far-off corner of the house, there to be enjoyed but not seen.

But radio broadcasting has brought about a change in radio engineering and designing of apparatus. It soon dawned on radio engineers that the receiving apparatus, as used in the average household, is only the means and not the end. It is merely the medium for receiving the broadcasted programs; in truth, the average person would as soon do away with the receiving set and use a plain tin horn, if such a crudity would give the desired results. The popular demand has been for more and more simplicity combined with greater and still greater efficiency.

The answer to all this is now evident. Radio engineers have done remarkably well—almost unbelievably well. They have eliminated the troublesome storage battery, they have devised new types of vacuum tubes the filaments of which require a minimum of current, which can be supplied by ordinary dry cells, they have worked out simple circuits which reduce the controls to a minimum while giving excellent results, they have developed good loud-speakers, which do away with the necessity of head-phones, they have designed attractive cabinets which now contain every component of a radio set, including the batteries. The result is the compact, attractive cabinet which is invading the sacred premises known as the living room. The highest development of this kind is in the form of cabinets resembling phonographs, containing everything, including the loud-speaker horn.

So, at last, we have the modernized version of Pandora's chest. In the corner of our living room we have a small, attractive cabinet, blending in with the general scheme of things. We step up to the cabinet, turn a small knob to light the filaments of the concealed tubes, and another knob to search for stations. We hear a faint whistle We move the knob more cautiously, dissolving the whistle into the strains of an orchestra We move a second knob, which gradually intensifies the orchestra strains until the desired volume of sound is obtained from the loud-speaker horn For quite a while we listen to the various selections of this orchestra, coming from the roof garden of a renowned hotel 30 miles away At 10 o'clock we tune in for the ringside in a neighboring city, where a much-heralded bout is being staged between famous heavy-weights. We hear the fistic battle, blow by blow, as well as the gong, the cheers of the throng, the whistle of the timekeeper, and other noises that go with pugilistic activities. The battle is soon over, and we know the results several hours before the newspapers are available from the city By now it is 11 o'clock, the local broadcasting stations have "signed off" for the night Again we explore with the tuning handle—a whistle—and then a jazz band Clear, loud; good. Then comes the announcer's voice. We learn that the jazz music is from a city half-way across the continent!

So Pandora's chest of fiction is now excelled by the Pandora's chest of fact. Once more, truth is stranger than fiction.

A Poorly Housed Business Institution

THERE is nothing adds to the success of a business institution more than proper housing. This is true of governmental business institutions as well as of private concerns. The United States Patent Office is one of the few offices in which the earnings are relatively large as compared to the expense, ranking in this respect with the Post-office Department, Customs Bureau, The Internal Revenue and similar income earning branches of our great Government. The Patent Office has a somewhat unique arrangement in that it runs what might be termed a large retail store, the stock of which is limited as to variety, but is almost unlimited as to quantity This is the branch of the Patent Office that is devoted to the sale of soft patent copies of patents. Millions and millions of soft copies of patents are stored in the United States Patent Office for sale at a very considerable profit and the number handled each day would gladden the heart of a merchant prince. Owing to inadequate facilities these copies are spread all over the Patent Office Building. In hallways here, in corridors there, and in vault

Our Point of View

rooms extending out under the foot pavements of the city and in tier after tier rising so high as to necessitate ladders to reach the upper row Many of them are on wooden shelves that increase the danger from fire and the spreading of the copies all over a large building necessitates the copy pullers traveling mile after mile each day in pulling the copies. A limited quantity of metal racks have been provided but these do not begin to supply the reasonable demand The copies are so distributed that it is difficult to promptly secure a desired copy, and this in a large measure reduces the sale, as instead of ordering copies the person desiring them will take the trouble to inspect the records of the Patent Office to avoid delay Much of this could be avoided by providing suitable metal racks for all the copies and also by providing for the arrangement of the copies in compact form and in close proximity so that the pulling of the copies will be greatly facilitated

The rooms housing the various Examiner's divisions are all seriously crowded, thus interfering with the work and adding delays where the delay is now of great inconvenience to the public, and some divisions are housed in the corridors where they are partitioned off by file cases and subject to all the interruptions and disturbances incident to those traversing the corridors.

The copies of foreign patents issued since 1914 were greatly delayed in delivery by the War, and when finally delivered to the United States Patent Office were delivered in such bulk that space is not available for the proper classification, nor is the Patent Office force sufficient to permit the proper classification of these copies, so that searches among the foreign patents are necessarily incomplete and extremely unsatisfactory

All of the foregoing could be avoided and the Patent Office be conveniently housed and well officered, if the recommendations in the Commissioner's report for the year ending December 31, 1923 had been carried out by Congress. As the Patent Office is really a business institution, serving the public and being well paid by the public for the service rendered, there appears nothing unreasonable in the desire and expectation that Congress will afford suitable facilities for the proper transaction of business which in itself is profitable to the Government.

The Navy's Contribution to Industry

THE present agitation in favor of the complete abolition of armaments and, therefore, of our splendid Navy, is unthinking, uninformed, and generally springs out of an abysmal ignorance of the subject To be consistent, the advocates of complete disarmament should call also for the abolition of those police forces which enable city dwellers to work and sleep in security

In a recent issue, we touched upon this subject, and laid special emphasis on the value of the Navy as a training school for our young men in habits of orderliness and discipline, and in respect for constitutional authority. We now draw attention to the fact, so generally overlooked or ignored, that the great merchant fleet which fetches and carries the products of industry is equally indebted to the Navy for the great technical improvements which have helped to raise it to its present standard of speed, comfort, reliability and high operating economy.

Take the fundamental question of ship propulsion. Less than 25 years ago the cumbersome reciprocating engine was in exclusive possession of the field, both as to freight and passenger ships, and it is largely to the ceaseless initiative and support of naval engineers, both here and abroad, that the world owes those successive improvements which have given to us, first, the direct connected-turbine, then the geared-turbine, and lately the steam-electric drive, which last has proved itself so satisfactory to our Navy that the latest battleships are equipped exclusively with this system. To the navies of the world, also, we are indebted for much experimental work in the development of the Diesel marine engine, which in economy of weight, space and consumption stands so far in the lead as to be in a class by itself.

But, although its work in developing improved means of propulsion is its greatest contribution, we must not forget that there are hundreds of other directions in which this great "*laboratory of experimentation*," as the Navy has justly been termed, has made generous contributions to industry The electrically operated winches, pumps, ventilating fans, and various other auxiliaries which are now being introduced aboard merchant vessels, have been in use for over fifteen years in our Navy Furthermore, the Navy was a pioneer in the use of super-heated steam, and the Merchant Marine is indebted to it for research work in developing alloys of various kinds for condenser tubes and other purposes, for its elaborate investigations of lubricating and fuel oils, and for its development on a large scale of electrical welding methods. The Navy's model basin at Washington, moreover, is responsible for improved models, not only of merchant ships but many of the notable steam and sailing yachts of the country In this connection, it may be stated that the lines of not a few of the American cup defending yachts received their final determination as the result of trials in the Navy towing tank When we come to navigation, we find that the Navy has rendered invaluable assistance To its Hydrographic Bureau, we are indebted for extensive marine surveys, and for the superb charts, issued regularly by the Hydrographic Bureau The ice patrol safeguards the passage of our great liners by locating and distributing by radio the position and course of those terrors of the seas, the icebergs. Many a good ship has been saved from disaster by the "radio compass" system, a Navy development by which ships as they approach the coast can obtain their exact locations, even when they are shut in by dense fogs and blinding snow storms. When a ship enters the harbor channel, she can maintain herself accurately within her narrow limits, keeping in electrical touch with a pilot cable laid on the bottom through the center of the channel. Only recently we illustrated in this journal the new Navy system of sounding by sound, the practical operation of which was recently proved when a Navy ship charted the ocean floor from America to Europe in a fraction of the time which would be necessary by the old method

Nor must we forget that the Navy gave to the steel industry in America the greatest single impetus which it has ever received. Thirty years ago, when we began to build our first steel ships, we possessed no mills that could fabricate the heavy forgings needed for armor plate and guns. Such things could be obtained only abroad, but the Navy arranged with American manufacturers to install the necessary plant for this heavy work, and it was this far-sighted policy which started our heavy steel trade on an upward course, which, within a few years, had made us the premier steel manufacturing country in the world. So far from its being an economic waste, the Navy is at once the police force of the nation, a training school for its youth, a great laboratory for the development of new industrial processes, and one of the greatest exponents of the true "live and let live" patriotism.

Adirondack Forest Preserve Threatened

THE ATTEMPTED raid by private interests on the Adirondack Forest Preserve, by means of an amendment upon which the people of New York State will vote on November 6, is a matter which affects every State in the Union, for if the amendment should pass, it will suggest and encourage similar action by private interests against the forest reserves in other States of the Union

The attack is being made under what is known as the Ferris amendment to section 7 of article VII of the State Constitution, in relation to the Forest Preserve. Section 7 reads as follows "The lands of the State . . . constituting the Forest Preserve . . . shall for ever be kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed. The Legislature may by general laws provide for the use of not exceeding three per centum of such lands for the construction and maintenance of reservoirs for municipal water supply, for the canals of the State, and to regulate the flow of streams. Such reservoirs shall be constructed, owned and controlled by the State"

Thus far the amendment follows the present constitution It then proceeds to provide for private exploitation, by adding a clause which strikes at the fundamental principle of the present law This reads as follows "The Legislature may also provide by general laws for the use of such lands for the development of water power for the public benefit and for the construction, maintenance and operation thereof of ponds, structures, conduits and appurtenances necessary for that purpose —Such development may be by the State, *or by a lessee of the State*, (the italics are ours), under a lease for a term not exceeding fifty years, to be secured pursuant to law on such terms as will best protect the public interest and transmission lines may also be constructed, maintained and operated on such lands by the State or by a lessee of the State, on like terms"

So there you have it and for cool effrontery, in its deliberate attempt to take from the public that which the constitution has expressly reserved for its use, this proposed amendment can hardly be surpassed

For look you, whereas the present law expressly forbids the leasing of State-owned lands within the Forest Preserve to any corporation, public or private this amendment permits the leasing of such lands

Whereas the present law limits any storage lands in the Forest Preserve to the supply of water for municipalities, canals and the regulation of streamflow, this amendment permits the building of conduits, power houses and electric transmission lines on these Forest Preserve lands

Whereas the present law provides that any reservoirs shall be operated by the State the amendment provides that they may be operated by lessees of the State, *i. e.*, by private corporations

Whereas the present law contemplates the use of water only the amendment contemplates the use of large stretches of forest land in the form of clearings for power houses and wide and lengthy avenues cleared of trees for transmission lines

This latest raid upon the Forest Preserve is nothing new More than once during the past thirty years the SCIENTIFIC AMERICAN has raised its voice against the conspiracy, as we do today Section 7 was adopted in 1894 expressly to save the forests on State land, and from that day to this the lumber and power interests have tried to break down that constitutional safeguard In 1896 they attempted to pass an amendment which was defeated by a vote of two to one In 1906 they tried again by last minute legislation which passed the Senate on May 1 and the Assembly on the last day of the session It was denounced by the press and was killed in the next Legislature

Only once since 1894 has this section been amended, and that was when the friends of the forests prepared an amendment, which was adopted and which permits, as noted above, only 3 per cent of the State-owned forest land to be used for storage for municipal water supply, for canals and to regulate the flow of streams, all of this for State purposes The Ferris amendment would invade the reserve with power-houses and cut wide swaths through the forests for the erection of unsightly lattice towers and the stringing of cables for the benefit of private interests. They would be protected by fifty year leases, under which there is no provision for compensation to the State for the valuable rights and privileges granted

Once more, at the forthcoming general election on November 6, the people of New York State will have an opportunity to register an emphatic "No" to the proposal to open our Adirondack forests for private exploitation.

The Father of Our Modern Navy

How Roosevelt Pulled the Navy Out of the Rut and Gave It a Fighting Edge

By Rear-Admiral Wm. S. Sims, U. S. Navy

IN ANSWER to our request for a Navy Day message, Admiral William S Sims has written this fine tribute to the share of Theodore Roosevelt in the upbuilding of the United States Navy On no side of his multitudinous activities did his penetrating mind and forceful personality work with quicker or more lasting effect He was the despair of the reactionaries and the joy of the younger and forward-looking officers of the Navy. To his conviction that nothing but the best is good enough for the Navy we owe, not only the rapid growth of the Navy in size, but, what is far more important, its advancement in efficiency During the Roosevelt regime our gunnery became equal to the best in the world, our ships were rid of many serious defects; dangerous open turret hoists were abolished, and the whole personnel became thoroughly imbued with the Roosevelt enthusiasm —THE EDITOR.

FEW people realize the debt we owe Theodore Roosevelt for the development of our national defenses, especially our first line of defense, the Navy Few realize the historical and technical knowledge he brought to bear upon this subject. The average man on the street does not know, or has forgotten, that during his young manhood, at the age of 24, he published one of the most remarkable historical narratives ever written by an American, *The Naval War of 1812* It shows an understanding of the fundamental requirements of naval efficiency that few officers of his time had achieved

The studies required to produce this book enabled him at once to understand the measures necessary to bring the Navy up to a state of efficiency from the deplorable condition into which it had fallen by the time he became Assistant Secretary of the Navy He knew so well the qualities of material and training that make a ship a reliable battle unit that when our deficiencies in these respects were presented for his consideration, he accepted the criticisms in the spirit in which progress demands that criticisms should always be accepted, and in which they are so seldom accepted by the responsible authorities. He insisted upon a thorough investigation of the actual facts, the fixing of responsibility, and the immediate initiation of the necessary measures to correct our mistakes.

Before his efforts were interrupted by the Spanish War, he had appointed a board of officers to inquire into the causes of our inefficiency in marksmanship, and to recommend methods of training to remedy this. After the war he found himself opposed by officers who pointed to our successes at Manila and Santiago, and who strenuously objected to any public criticism of what they declared was a Navy that left nothing to be desired in the way of efficiency of either material or personnel He understood so well the conservative attitude of military men that he insisted upon an impartial presentation of the actual facts, and a comparison of these with the target practice records known to have been made in foreign navies. Needless to say, the record of about one hit in 50 shots at the battle of Manila, and of one in about 30 at the battle of Santiago, showed him the seriousness of the situation, and these records contrasted with the astonishing results of the new methods of training in the British Navy convinced him of the necessity of taking the matter in hand himself.

This he did by ordering the new British training methods put into operation, and ordering all gun gear and gun sights changed to make these methods possible with our guns. Within a short time the improvement was so astonishing as to be difficult of belief The rapidity and accuracy of fire, the "hits per gun per minute," were increased to such an extent as to indicate that in battle we should be able in one minute to land two tons of heavy projectiles against an enemy's hull at a distance of three miles, whereas, formerly we would not have been able to hit an enemy more than twice in an hour's firing It was an increase in efficiency of over 3,000 per cent.

At the same time he gave his personal attention to the question of ship design He grasped at once the significance of the new target practice records—the fundamental fact that the big turret guns could make a high per cent of hits at a range at which the few hits that small guns could make would do little damage. He at once advocated the All-Big-Gun ship, the modern dreadnought, but he found, as usual that the new type was opposed by the Navy Department This opposition he would speedily have overruled had it not been for a much more serious obstacle—the force of public opinion created by an article by Admiral Mahan advocating the small gun as the principal battleship weapon. This made it impossible for the Congress to approve the dreadnought type Nothing deterred, he insisted upon an analysis of the subject for the purpose of showing that Mahan's arguments were based upon wholly mistaken information concerning the hitting power of a battleship's heavy gun at long ranges. These conclusions he gave to the press, thus bringing about the surrender of the Chairman of the Senate Naval Committee, who came out strongly for the new type, which was forthwith ordered designed.

Unfortunately the first of these ships were badly designed, and were at once criticized by Commander Key These criticisms were opposed with all of the power of the principal dignitaries, but Roosevelt, as usual, insisted upon a showdown of all the facts. He caused the whole matter to be discussed by a body of about fifty officers in a conference which he opened in person at the Naval War College at Newport. The result was that the defects criticised were corrected, as far as possible in ships partly built. But, more important still, measures were ordered that would make sure the avoidance of such mistakes in future designs; and since that time the design of our battleships has been second to none in the world.

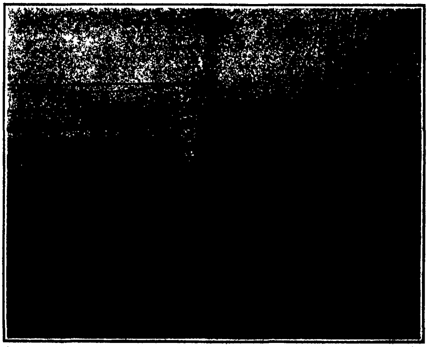
In addition to correcting such vitally important defects as those above indicated, both in design and in methods of training, he gave his attention to many of the major details upon which efficiency depended. To cite but a single example, he used his powerful influence to overcome the opposition to correcting the incomprehensible defect of open turrets—wide open at that time from the gun platforms down to the magazines directly below The danger of this design had been frequently pointed out, but was successfully denied until it was demonstrated by the terrible turret accidents that resulted in the death of many of our officers and men.

The consternation caused by these horrors was such that the Department actually advocated the abandonment of all efforts to increase the rapidity of fire of our heavy guns, and advised that the records of our competitive target practices should be based upon the percentage of hits only In this crisis Roosevelt showed a comprehension of the wholly essential element of battle efficiency indicated by the phrase "hits per gun per minute," the standard of comparison then in use in our target practices. In a stinging letter he gave orders that we should continue to make every effort to increase the rate of hitting—to put more hits into an enemy's hull than he could put into ours in a given interval of time, and he made it clear that it was up to the Navy to risk any dangers that such training might involve.

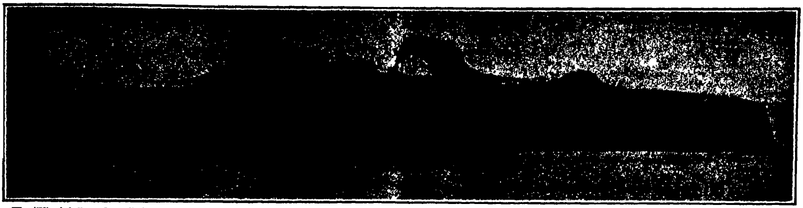
But more important still than the essential changes in design and methods indicated was the change wrought by the great spirit behind it all. In no line of his multitudinous activities did his penetrating mind and forceful personality work with quicker or more lasting effect. He was the despair of the reactionaries and the joy of the younger and forward-looking officers of the Navy Every man on every ship, from the captain down, soon realized that there was a master mind insisting that nothing but results should count; that "the only shots that count are the shots that hit" Since then we have had a new Navy—a Navy whose officers insisted upon efficiency, and therefore temperance, long before it was generally realized that the maximum mental alertness and manual dexterity necessary to efficiency in dangerous occupations cannot be achieved by men addicted to the cocktail habit.

This great man jarred the old-time Navy out of its complacent conceit He well understood, and tried to make the Navy realize, that the greatest danger in a military organization is dry rot, resistance to progress, and the substitution of a comfortable administrative routine for preparation for war. He was never tired of quoting the remark of a disgusted bureau chief who complained that "my department was running smoothly and perfectly until this damned Spanish War came along and upset everything."

It is fitting that the birthday of this remarkable man should have been selected as our National Navy Day He was the father of our modern Navy He instilled into it a spirit that brought into play the dormant, sterling qualities of the personnel. He gave the word efficiency a new meaning. He cared nothing for show, he was not impressed by spotless decks and the polished gear of guns that could not shoot fast and straight. He was impatient of ceremony. He stuffed cotton in his ears, went into the fighting tops of battleships and had his hat blown off by the blast of heavy guns. He went down in submarines. He thus made his interest as real to the youngest gob as to the senior admiral. All understood that he valued the Navy only in proportion to its demonstrated ability to defeat an enemy in battle. He gave it the fighting edge. Though he is dead, this remains; for his spirit still lives and will always be a cherished tradition and an invaluable inspiration in the day of battle.



President Roosevelt (seen at top of gangway) returning official call of Commander-in-Chief, United States Atlantic Fleet, on board flagship "Tennessee" at naval review off his home at Oyster Bay in 1904



The "Virginia" as she rolled over to starboard before sinking in the September, 1923, tests. Bombs that dropped aboard threw down the two lattice masts and the three smoke stacks. It should be remembered that the ship was anchored; that she had no anti-aircraft guns, and that the bombs were dropped, without interference, from the low elevation of 3000 feet

Has Sea Power Passed?

An Authoritative Exposé of the Extravagant Claims of the Air Enthusiasts

By Rear-Admiral Albert Gleaves, U. S. N.

SO MUCH publicity has been given to the alleged performances and capabilities of aircraft as an argument against the continued development of our Sea Power, that the Navy Department has uttered its official protest against the repeated attacks of the air enthusiasts who contend that Air Power is not only an extension of the Fleet, but that it has actually superseded it and rendered the battleship obsolete

In the July number of the *Fortnightly Review*, Mr Archibald Hurd says that the doctrine that Air Power has rendered Sea Power more or less obsolete involves not only the extinction of the Navy but the extinction also of the Mercantile Marine, "and we are offered nothing in place of the one or the other, which can be regarded as satisfactory, for the airplane has a very short radius and the airship is still a thing of the future, both are indeed in the experimental stage" He points out that as airships have to sustain their own weight as well as the cargo, while the surface ship is borne by the water, that airships can never replace merchant ships, and the extinction of merchant ships would be the extinction of trade.

This is not written to discredit aircraft, but to warn against what President Roosevelt would call the "mischievous folly" of those who assert that our national defense and offense has passed from sea to sky Every sane man believes heartily in the so-called "Three Plane Navy," aircraft, ships and submarines, and even naval airmen repudiate statements to the contrary

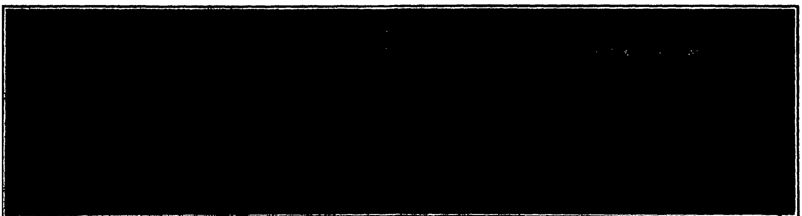
The air enthusiasts base their arguments mainly on the bombing experiments against the Alabama and Ex-German ships off the Virginia Coast, July, 1921, and reinforce their opinions with those of certain British Naval Officers. The controversy they have projected contains many factors, which if carefully examined, will expose the fallacy of their impeachment of battleships, guns and forts. Recognizing the immense importance of aircraft, our duty toward Air Power is plain. We should, *(1) Put aircraft of the right kinds and as many as possible on every surface ship belonging to the Navy (2) Build all the aircraft carriers we are allowed under the treaty and operate them with the fleet*, (3) Augment the Navy with 10,000-ton *cruisers* and 10,000-ton small "carriers" *of such type* (if there be one) as the limited displacement permits, Provide fixed air base defenses for the Canal, for our naval bases and for our great commercial ports, navy yards, and other vital positions. If we do these things we will have done everything the air development of the day warrants. More than this we cannot do under the Treaty

When the Conference for the Limitation of Armaments met at Washington, the United States was on the eve of becoming the greatest Sea Power in the world, a consummation naturally not pleasing to England which had held the trident of Neptune for 600 years, or to Japan which aspired to be in the Far East what England is in Europe It will be recalled that the Conference agreed to restrict the number of battleships and airplane carriers, certain tonnages were also restricted as well as the size of guns. With few exceptions, American Naval Officers will remember the Conference with a pang of regret. To the air radicals, however, it was a boon. "We have enough battleships," they say, "forts are useless, and the only proper defense of our bases is by airplane, submarines and mines."

In every discussion of the question the air-enthusiasts present visionary, not to say fantastic, pictures to prove that Air Power has conquered the sea and eclipsed the battleship. A recent article describes the annihilation of the United States Fleet of 12 modern 30,000 to 40,000 ton battleships, and the fortifications at Honolulu, by a Japanese Fleet of 12 plane carriers of 10,000 tons, *35 knots speed*, each carrying 50 bombing planes. It is interesting reading and would make a good film story, but will unfortunately confuse and mislead the lay mind. The fact is a 10,000-ton carrier such as described could not possibly stow 50 huge planes with personnel and equipment. It is practically certain such a ship, so far as may be seen now, could carry only a few bombers *and could not launch any* In the "battle" the shore defences are allowed only a "few" planes and our fleet none at all except the light planes carried in the 'Langley'"

The air enthusiasts when confronted with the poor record of aircraft in the North Sea, retort "Air Power did not appear at Jutland today it dominates in warfare" Air Power did appear at Jutland and before, the Germans had highly developed airships at the beginning of the War and the English had airplanes It was an airplane that discovered and reported the approach of Von Hipper's battle cruisers, and was driven off by gun fire when it attempted to bomb the German ship. As early as November, 1914, an attack by sea planes was planned upon the Zeppelin sheds at Cuxhaven, but in the prevailing weather the planes could hardly get off the water (World Crisis, p. 490) The failure of his aircraft to locate Jellicoe's Fleet delayed Von Scheer eight days and changed his whole plan of campaign Air Power failed at Jutland and in Heligoland Bight, because aircraft could not operate in a fog, nor can they now They would have failed at Coronel for the same reason The high speed of the battleships and cruisers in all the actions of the War—23½ to 28 knots—makes it doubtful if, with their present sighting appliances, airplanes could have succeeded either in the North Sea or in the southern oceans. They were of some service at the Dardanelles when a balloon was used for spotting the shots of the Queen Elizabeth across the Gallipoli Peninsula and it was a success there only because it was used as an adjunct to Sea Power Air Power and Sea Power are so interlocked and interwoven as to be inseparable

Opinions of distinguished British Naval Officers are quoted to impeach the battleship. Lord Fisher is the principal witness. He is quoted as saying "'Scrap the lot—referring to battleships.'" One wishes that, in the interests of truth, chapter and verse had been given for this quotation. He did say once, and the expression



Smoke screen cast by one of the Army airplanes during the 1923 tests. The heavy falling gases formed a screen in front of the "Virginia" and "New Jersey," rendering the ships barely distinguishable in the distance

has been often repeated, "Sack the lot," but he was referring to reactionaries in the Admiralty, not to battleships. On another occasion he wrote in 1915, "I am busy scrapping parasites," ("In the North Sea with Beatty") again referring, not to material but to personnel. Lord Fisher was a strong advocate of aircraft as *auxiliary* to the Fleet (Memoirs) and he regarded "The Fleet ready for action as a National Life Preserver" (Letters to Edward VII)

The enthusiasts of the Air School even invoke the spirit of Mahan in their impeachment of Sea Power. It is impossible to conceive the great apostle of Sea Power as denying the doctrine he preached for 30 years, or looking upon super-dreadnaughts as "shadows of the past," as an air enthusiast puts it. Could he speak on the subject he would probably say, as he did when he approved the use of gas shells, modifying his words to suit the new invention. No airplane capable of carrying a bomb of sufficient capacity, or of propelling it with such accuracy as to sink a battleship under *war conditions* is as yet in practical use, or has undergone adequate experiment. consequently we are ignorant of the facts as to whether the results would be of a decisive character or whether injuries in excess of that necessary to the end of warfare, the immediate disabling of the enemy, would be inflicted. Captain Mahan was a true prophet when he foretold that the Zeppelins would be found to be greatly overrated. (Life of Mahan. Taylor)

From one era of invention to another there must be a transition period of try-outs and experimentation. We do not abandon a perfected weapon and replace it by an undeveloped invention, the radio has not yet replaced the telegraph and the telephone, and fifty-odd years intervened between the fight of wooden ships at Hampton Roads and the battle of the super-dreadnaughts at Jutland. It may be we are at the threshold of a new era, and the airplane model of 1980 may be an armored battleplane of 100 tons, 12,000 horsepower and 200 knots speed, carrying 50-ton bombs, as foreseen by M. Bréquet, but in the meantime we must be prepared to win a war with weapons in hand. The Navy, which is our first line of defense, must be kept up to the highest efficiency, equal in all respects to that of Great Britain, and five-thirds of Japan's. It is unfortunate that the Limitations Treaty did not make this obligatory

The Bombing Experiments of July, 1921—These tests, which have started so many controversies, in no respect simulated war conditions and this is largely true of the tests recently carried out against the "Virginia" and "New Jersey" The 1921 experiments were postponed from time to time until the weather was clear, the sea smooth and the wind light. In all 75 Army and Navy planes were used. They flew low down over stationary, defenseless and abandoned ships, and undisturbed, dropped bombs of 150 pounds to 1000 pounds of high explosives. In 1923 the "New Jersey" was sunk at 6000 feet and the "Virginia" at 3000 feet. Today we have machine guns and light guns that can spray the air with aimed projectiles at these elevations.

According to the report of the Joint Navy and Army Board on the 1921 experiments, the practice was not as good as was to be expected under the selected favorable conditions. It is a fact that it required 9 hours and 37 minutes to drop 78 bombs (26,851 pounds) on to a cruiser and destroy it, much more time than it took Jellicoe to sink by gunfire one battleship, one battle cruiser, four light battle cruisers and five destroyers and kill and wound 2800 men

The "Ostfriesland" was sunk by the mining effect of bombs which fell close alongside, this brought out nothing new because it was well known that mines can and have sunk ships, but it is not so generally known that unless the explosion is practically in contact with the side or within a few feet of it the effect is not serious. Even if a ton of T N T were exploded 100 feet from the ship's side the effect would be equivalent to the explosion of only 2¼ pounds alongside, not enough to injure a torpedo boat. To argue then that the sinking of the "Ostfriesland" which be it remembered, was unresisting, practically at anchor, no one on board to pump out flooded compartments, and not provided with the latest under-water protection, "proves that if our coast is protected by airplanes no ships can reach our shores or land troops" is an example of special pleading which would not be admitted in a court of law.

In discussing this practice it should be remembered that the difficulty of getting hits with bombs or aerial torpedoes is vastly increased when the attackers meet opposition. It is one thing for an airplane to stand toward a defenseless target and, at its leisure, drop its bombs or torpedoes, but quite another to maneuver this way and that in the approach, fight off defending planes; and drop missles accurately. Sights must be set for every change of course of the planes and to set them accurately requires some steadying on the new course. Thus, when attacking a *defended* ship *accuracy* is enormously reduced and the per cent of effective hits becomes very small. Could airplanes get 100 per cent of hits (which is utterly impossible) in practices like that at the "Ostfriesland," it would not prove they could get 5 per cent of hits when attacking against opposition

> *WE have long been of the opinion that there are few deficiencies in the makeup of the average man that are so destructive of clear thinking as the lack of a sense of proportion. The latest proof of this is to be found in the columns of arrant nonsense that are being printed these days, about the doom of the battleship and the dominance of the airplane. A few airplanes drop bombs on an anchored and defenceless old battleship and, presto! all battleships, even if they are moving swiftly and bristle with antiaircraft guns, are forever helpless. With indisputable facts and remorseless logic, Admiral Gleaves in this article punctures the airplane fallacy*—THE EDITOR.

One of the recent claims of air enthusiasts is that *altitude* does not play a great part in the accuracy of bombing. They claim that with improved sights bombing from altitudes of 5000 to 8000 feet can be quite accurate, in fact more accurate than from lower altitudes where the plane is under anti-aircraft gunfire. It is obvious that a bomb dropped from an airplane has an initial vertical velocity of zero, and being propelled downward only by gravity cannot have the accuracy of a shell fired with an initial velocity of 3000 feet per second. The low velocity, of course, greatly increases the errors due to wind, speed of airplane, speed of target and earth drift. Nothing but the high initial velocity of gun fire can minimize these factors; therefore air bombing affords no reasonable basis for the claim that the battleship is doomed. With the improved sight the chance of hitting a vital spot, the conning tower, for instance, is slim even at low altitudes, when opposed and within anti-aircraft gun range. The probabilities by trial and error of hitting the deck of a large ship decreases from 50 per cent at 1000 feet altitude to 17 per cent at 8000 feet.

Bomb falling in the water near the "New Jersey." Such bombs, if they detonate sufficiently close to the ship, are more fatal than those which make a direct hit

Airplanes carry from 500 to 1000 pounds of T. N. T. Planes carrying 4000 pounds are contemplated, but do not exist today. The heavyweight bombers cannot yet be launched from plane carriers and must be operated from shore. Heavy weights carried by bombers limit the radius of action to 500 miles at the comparatively low speed of 80 to 100 miles per hour. It is evident such planes are greatly handicapped in attacking ships at sea. As one plane can carry but one large bomb or torpedo, when that missle is launched the plane must return to the base or to the carrier for a reload. Air enthusiasts seldom admit this fact into their calculations. Also they assume that planes can go to and fro direct between the base or carrier and the target ship when, as a matter of fact, they have to *search* for their objective—*and do not always find it*. Leaving these considerations out, air attacks become easy on paper. Naval aviators and officers who practice with aircraft actually or on the maneuver board recognize these points; there are some others who do not.

Airplane Carriers.—The big carriers will be equipped to carry 110 planes of various types; but the trouble with the carriers is that as yet they cannot launch heavy bombers, nor can the other types land or take off in rugged weather. To operate airplanes from an board ship the sea and weather conditions must be favorable. In launching or taking on planes, carriers must point nearly into the wind. This is seemingly a minor point; but it is amazing to what extent that little fact interferes with the airplane. It often makes carriers go where they don't want to go and do what they don't want to do. Hence carriers cannot always launch and take on planes at the time they wish. If the wind is *fresh* or even moderate they must steam very slowly into it to get their planes off. If enemy surface ships are near, carriers have to run fast and frequently not to windward. At such times they can't handle planes at all. It often takes the whole battle line to protect carriers while they are launching planes or taking them on. Air enthusiasts don't seem to have ever heard of this fact.

Another point that the air radicals never consider is the time it takes to launch planes from a carrier. Carriers can launch planes only one at a time, as very few planes can be kept on deck ready to take off, the rate of launching will probably not exceed one in four or five minutes.

Torpedo Planes.—The airplane torpedo weighs about one-half ton and therefore can, as yet, be launched only from planes sent up from shore. Although not fully developed the torpedo plane has great possibilities. Already the air enthusiasts are making extravagant claims for it. They say that the carrier is the equivalent of a gun that will shoot 100 miles, and discharge a projectile containing hundreds of pounds of explosives. They explain that the carrier having chosen its distance, 100 miles or so from the enemy fleet, will send up its torpedo planes which will attack at dark or dawn, when within torpedo range (5000 yards) fire their shots *unobserved* by the enemy! They do not say how the carrier or planes are going to escape detection by a vigilant enemy who will be protected by a screen composed of submarines, destroyers and aircraft, *thrown out at a distance of 30 miles* from the battleships and the "train."

The effectiveness of the torpedo plane has only been partially tested in war. In a recent target practice torpedo planes fired 18 shots at the "Arkansas" which was zigzagging in *smooth* water at a speed of 15 knots, and scored 44 per cent of hits, of course conditions were totally dissimilar from war, and were all in favor of the planes. As the planes had to come down within 20 feet of the water to release the torpedo, and as the range was only 1000 yards, under war conditions they would easily have been destroyed by gunfire. This practice was justly considered encouraging, but an air enthusiast called it "an appalling success."

It is often claimed that if we were "amply provided" with airplanes, but had no *battleships or forts*, the planes alone could prevent a landing and invasion by an enemy. This can only be a matter of opinion which cannot be verified. What would be an "ample" number of planes? Assuming that one per cent is the basis in the Army (*i. e.*, Army of 500,000—airplanes 5,000) and that each Naval District will have an active Naval Air Station for defensive sea patrol, scouting operations, etc., and that the cruisers have their full allowance, a hostile landing could be made difficult, but not impossible; nothing more definite than this can be predicted. Counter aircraft attack must be considered, and this is rarely, *if ever*, done by the air enthusiasts who generally give the "defender" all the planes he could wish without considering the practical details of getting them into action. It would be interesting to figure out, as a percentage of hits made, how many

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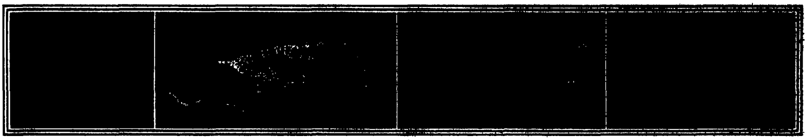
NEW LIFT BRIDGES ON THE JERSEY CENTRAL RAILROAD ACROSS NEWARK BAY

SEVERAL of the railroads which have their New York terminals in Jersey City or Manhattan have to cross the Hackensack River or Newark Bay when they enter or leave the meropolitan area. In the case of the Central Railroad Company of New Jersey, this necessitates a long crossing in a location which intercepts the water-borne traffic to and from the City of Newark, with its large manufacturing interests. Consequently, the War Department calls for the provision of some form of opening through the bridge to permit the passage not only of tug boats and lighters but also of the large sea-going vessels whose terminals lie in the upper reaches of Newark Bay. In the past the bridge had to be opened for the majority of the water-borne traffic, and this has resulted in frequent delays of the railroad service. The new bridge will obviate this delay.

Hitherto, the railroad has been served by a timber trestle track, with a swing bridge over the main channel; but lately it became desirable to replace the old bridge with a steel structure of thoroughly modern design. The new bridge which carries four tracks is located 100 feet north of the present structure. The track level will be 80 feet above that of the present bridge and 40 feet above mean high tide. This raising of the level will provide a clearance of 35 feet above mean high water, when the lift bridges are in the lowered or closed position, with the result that 75 per cent of the water-borne traffic will be able to pass under the bridge when it is closed. Moreover, very little of the traffic will require a full lift of the bridge.

In the Newark Bay crossing, the Central Railroad Company has provided two channel openings, one (the further one in the illustration) having an opening 125 feet in the clear and the other a 200-foot opening. Except as to dimensions, they are identical. It will be noticed that on each side of the channel opening is a lofty, steel, framed tower presenting a vertical face to the opening. Each tower rests upon two piers, one on the edge of the channel and the other placed back of it, at a sufficient distance to provide a broad base for the tower. Each tower consists of four vertical trusses of great strength and rigidity. On the inner faces of the towers, adjoining the channel, are four vertical guideways, in which the ends of the movable span of the bridge travel, when it is raised or lowered. The lifting is done by means of eight heavy cables which are attached to the bridge, pass over the heavy pulleys at the top of the towers, and are attached to massive counterweights, which in the 200-foot span are shown at the bottom of the towers, and in the smaller span, which is shown in the lowered position, will be noticed near the top of the towers. The counterweights are so nicely adjusted, that the raising or lowering can be done by electric motors of moderate power, which are controlled from the operating room, located on the top chords of the bridge. The excess weight of the spans is so small that the bridges can be raised to their full height in two and a quarter minutes. It should be mentioned that when they are in this position, there will be a clearance of 135 feet below the underside of the spans at mean high-water, which is about the same clearness as that of the center of the Brooklyn Bridge over the East River. This will be ample to clear the masts of such deep-sea ships as may wish to pass through the bridge. The approach spans will be steel girders 125 feet in length, which will be supported on concrete piers laid on pile foundations.

The foundation work for the new bridge is extensive and involves a large amount of dredging, caisson work and laying of concrete. The massive piers for the lift bridges will be carried down to rock at a depth of 60 feet below water. The piers for the approach spans are built of concrete on pile foundations. The necessary excavation is being done by a dredge with a cutter seven feet in diameter, which is capable of handling from 6,000 to 20,000 cubic yards per day. The excavated material is pumped ashore and used for filling at one end.



Dr Geley emphasizes that the anatomical forms are usually perfect. Only three or four of the molds are defective, and even on these there are parts that show perfect anatomical detail. The casts show every detail proper to human hands and feet the general form, the bony protuberances, the muscular outline, the small veins, the lines, the fine marks of the skin. Nothing is missing

Molds showing hands and feet of children. The two at the right are different views of the same mold, otherwise all four molds shown are distinct

Materialized Hands

The Franek Kluski Wax Molds, and the Conclusions that May be Drawn from Them

By Dr. Gustave Geley, Institut Metapsychique International

Translated for the SCIENTIFIC AMERICAN by Stanley de Brath, M. I. C. E. (British)

MUCH reference has been made, in psychic controversy of the past two years, to the paraffin casts of hands and feet obtained by Dr. Geley in the presence of the Polish medium Kluski. We think it probable that the bare existence of these molds has been known to most American readers interested in psychic matters. But when Mr Bird was in Paris and saw the originals, he realized at once that no adequate account of them had appeared in America, if indeed at all in English. He accordingly arranged with Dr Geley for a comprehensive article describing the molds, the mode of their production, and the procedure of the French investigators in reaching the conclusion that they were genuine. Dr. Geley has sent the manuscript, for translation, to Mr de Brath, who rendered into English Richet's monumental treatise "Thirty Years of Psychic Research," and who is himself one of the leading British spiritists; and in this way our readers are assured of a translation that shall not suffer through any lack of special knowledge of the subject on the part of the translator. Whether or not our readers are prepared to follow the author in all his conclusions, they must realize that he presents a psychic document of the utmost importance.—THE EDITOR.

THE STORY of materialized human members constitutes one of the most interesting episodes in the progress of metapsychic science. The sharp definition and precision of the results obtained, and the impossibility of attributing them to any kind of fraud, make them one of the most incontrovertible proofs of the reality of ectoplasmic manifestations. We may here remind readers in what these ectoplasmic manifestations consist. They are a kind of exteriorization of the physical personality of the medium. During trance a portion of his organism is externalized under the appearance of an amorphous substance which may be either solid or vaporous.

This amorphous substance then takes organic forms, and from it or in it there appear new forms, which, when the phenomenon is complete, are capable of assuming all the anatomical and physiological characters of living organs. The ectoplasm has then become a living being or a portion of such a living being, always, however, closely connected with the body of the medium, of which it is a kind of prolongation, being re-absorbed into his body at the close of the manifestation.

The phenomenon is assuredly objective. It cannot possibly be explained by hallucination or illusion of the experimenters. This is *proved* by photographs and molds taken in wax. These wax molds are specially interesting. They reproduce the exact form of the materialized member and allow the thorough examination of every detail.

The materializations being very short-lived, only a very rapid process can be used to get casts of them. The best, or rather the only known method fulfilling the necessary conditions, is by utilization of melted paraffin wax. This method was invented in 1875, in America by Mr Denton, a professor of Geology. It was also employed in London by Mrs. Reimers and Mr Oxley, who obtained excellent results. Since then as far as I know, no medium has, till lately, been found capable of giving these molds, for the very good reason that none have produced complete materializations having three dimensions (length, breadth and thickness), a complete anatomical structure, and lasting long enough to allow of the operation of molding.

For this operation a tank is provided containing paraffin wax kept at melting-point by floating on warm water. It is placed near the medium during the séance. The materialized "entity" is requested to dip a hand or a foot, or even a part of the face, into the melted wax, repeating this two or three times. A coating of wax is at once formed, closely adherent to the part so dipped. This coating hardens very quickly in the air, or by being dipped into cold water provided in a neighboring tank; then the hand or other organ is dematerialized and the "glove" remains behind. This "glove" is afterwards filled with plaster of Paris, and the cast is freed from paraffin by placing the whole in hot water. We then have a cast reproducing the materialized organ in every detail.

I shall here speak only of the experiments at the International Metapsychic Institute, referring the reader to the books by Professor Aksakoff (Animisme et Spiritisme) and by Delanne (Les Apparitions Materialisées) for the story of the earlier experiments. Our molds of materialized human members were obtained through the mediumship of Mr Franek Kluski, during the course of the years 1920, 1921 and 1922, at first in the laboratory of the Institute, and afterwards at Warsaw.

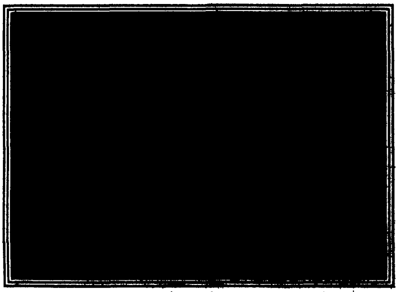
In Paris, the laboratory is a large bare room without windows. The doors were bolted from the inside. A dull red light enabled us to observe any movements by the medium. Mr Kluski, before entering the laboratory, turned out his pockets, and I satisfied myself that he had no box or any other object in his possession. The experimenters, who were always few in number (Professor Richet, M de Gramont, Count Potocki, and sometimes Colonel Okolowicz), sat around a table, on either side of the medium. Both his hands were held, by Professor Richet or M de Gramont on one side, and by myself on the other. The medium soon fell into trance, his head resting on the shoulder of one or other of the persons next him, and made not the slightest movement. A luminous phosphorescent cloud proceeded from his body, especially from his head, organic forms appeared in condensed portions of this cloud of vaporous ectoplasm, and soon developed into hands and faces having all the appearances of life.

To obtain molds the tank containing the melted wax was placed on the table before the séance, two feet from the medium. The molds were formed on request. The operation usually began after a wait of some 20 minutes, and was accomplished very quickly—in one or two minutes. This somewhat surprised us, as paraffin wax at the temperature of the room does not solidify so quickly. According to Dr Kluski, it would seem that the operating entities can alter the temperature of the member in the mold at will, and can cool it sufficiently to cause the paraffin to solidify; we give this explanation as given to us, only remarking that the hands of a medium in trance often become suddenly and considerably cold.

The operation took place in two or three stages, the acting hand plunged into the tank, came out covered with warm wax and touched the hands of the experimenters, then dipped again into the tank. After this, the glove, still warm, was put down, usually against the hand of one of us. We obtained one or two molds at each séance. Later on, at Warsaw we sometimes had three. In all, through the mediumship of Mr Kluski we have had 25 molds, of which 17 are of a single hand, five of two hands joined, two of feet, and one of the lower part of a face.

The size of the molds varies; some are full-sized male and female hands, some are those of children of 10 to 12, and some smaller, corresponding to hands of children from five to seven. In detail, there are seven hands of children of five to seven years old; one foot of a child of that age; and one corresponding to a child of 10 to 12 years old. All the other organs are those of adults.

The molds are all in a single piece without the slightest joint, even when of



Two separate molds showing two hands joined

a hand up to the wrist. They are all extremely thin, the wax being only a millimeter thick and often much less. The walls of the molds were in places so thin that in drying they developed small cracks from which portions of plaster escaped during the subsequent casting. We call particular attention of readers to this tenuity of the skin of wax. We have shown these casts to artists, painters, sculptors, molders and medical men. All have unanimously agreed that they are casts from human hands. One report from eminent artistic molders—Messrs. Gabrielli, Marchetti and Marettini—says

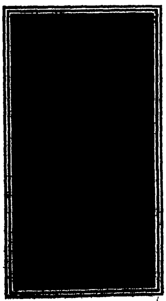
"Our third remark is on the delicacy and truth of the anatomical detail. Life is to be felt under these strange and deceptive casts. It is obvious that these molds have been made from *living hands*. We find in them not only the anatomical details but traces of muscular contraction that can be explained only by movements directed by will. There are slight crumplings of the skin which leave no doubt on the subject.

"From our long and minute examination we are compelled to conclude that molds so perfect, with such delicacy of detail, with indications of active muscular movement and folds of the skin, could only have been obtained on a living hand. They are molds taken at one operation, originals and not made from impressions."

Our certitude of the metapsychic origin of our molds rests on several proofs, some of which are absolutely incontrovertible. First we have the proofs based on control of the medium. We have stated above under what measures of control the molds were taken. The chief of these—the strict holding of both his hands—should produce complete conviction. We can affirm that during the séances the medium could not at any time have used his hands for trickery. I always myself held one of his hands and am quite certain that I never released it. Still further, in the experiments at the Institute it often happened that Professor Richet and I, controlling the medium, approached our hands holding those of the medium until they were in contact. Under these conditions, when we both could be quite certain, without any possible doubt, that Kluski's hands were completely immobilised, molds were produced. Further, as previously stated, we several times observed the simultaneous molding of two hands, clasped together. In such cases, it would have been necessary that the medium, to make molds of his two hands, should liberate both at the same time. This was absolutely impossible. As for the supposition that the medium could trick by making such perfect molds by using something other than his hands, this is so absurd that it does not deserve discussion.

Child's hand, reduced about one-third from the original. Here perhaps more than in any other single cast the impossibility of normal removal of the original from the paraffin appears

A second consideration is the proofs based on examination of the casts. We have already shown that our molds were indisputably made on living human hands. This at once disposes of the hypothesis of a fraud by aid of an India-rubber glove. We have endeavored to reproduce similar molds from an India-rubber glove distended with water, dipped into paraffin, and emptied for withdrawal.



An exceptionally fine adult female hand, on which the paraffin shell is no thicker than cigarette paper

This can easily be done, although with air the experiment fails as the thing floats on the top of the paraffin. The coating of paraffin must be thick enough to prevent fracture on withdrawing the rubber. But the result obtained is characteristic of the process used; there are none of the precise details of the human hand, and even its general appearance is absurdly deformed—a caricature of a hand. This deformation is inevitable when we are using India-rubber or any supple object. Even supposing an artificial hand artistically prepared so as to reproduce the lines of the palm, the creases of the skin and the nails all complete, this simulacrum *could not be distended with water without completely deforming it*.

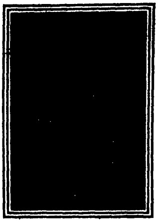
We think ourselves able to assert that it is impossible to imitate our results with flexible India rubber. Could they be imitated by using a hard object instead of a flexible one? All our endeavors to do this have been fruitless. The object could not be released from the coating of paraffin, which always broke or was hopelessly deformed. In vain did we give the waxen glove considerable thickness to give it resisting power—a thickness out of all comparison with that of our molds. We greased the thing carefully and made a long slit in the narrower portion representing the wrist, so as to facilitate withdrawal, but in vain. All these artifices produced no result. Even if we admit that others might be more skillful or more lucky than we were, we should none the less be justified in asserting that it is not possible by using a hard object to produce paraffin gloves analogous to our own both in respect of form and thinness.

But another question immediately occurs. Can these super-normal molds be imitated, using a normal living hand? The answer is easy. It can be done, indeed there is no other fraudulent process possible, but this process is both imperfect and very difficult. We took every precaution against trickery of this kind. This, however, necessitates a long explanation.

The first point to be cleared up is—How can these supernormal molds be imitated, using a normal living hand? We know two methods that can be used. The first and simpler, consists in plunging the hand into warm paraffin several times and awaiting the complete solidification of the glove (which takes 15 to 20 minutes in the air and from six to eight minutes in cold water). Then an incision is made with a razor or sharp knife along one of the edges, from the base of the fingers as far as the wrist. The hand can then be released by small lateral movements which detach it little by little from the waxen glove. The edges of the incision are then brought together and quickly re-dipped into the paraffin to conceal the joint and thus get a mold in one piece.

The joint does not show much if the operation is well done; but in order that it may be successful, one condition is indispensable—the glove must have 10 to 20 times the thickness of the super-normal molds. We have been unable by this process to obtain *thin* gloves, because these were always fractured on withdrawing the hand. Further, this process can only be applied to an extended hand. It would be quite impossible with one in the positions in the more surprising photographs shown. Also careful scrutiny always shows some traces of the joint. It can therefore be affirmed that this process could not have been used by the medium, even if our control had not placed an insuperable obstacle to its employment.

The second fraudulent process is more complex. It consists in using the hollow mold of a human hand. Into this mold some substance such as melted sugar, both fusible and soluble, is poured. When solidified it is removed from the mold and dipped into the paraffin; it is then placed in a tank of cold water and left till the cast dissolves and the glove remains. An improvement on this, we have been told of, but have not tried, consists in replacing the sugar by water frozen at 8 to 10 degrees (Centigrade) below freezing-point. A cast in super-frozen ice is thus obtained. It can be quickly plunged into melted paraffin and a very thin glove is once formed before the cast begins to melt and effaces the creases of the skin. The ice can then be left to melt and we can then get a glove as thin as desired.



The ludicrous result that Dr. Geley gets when he makes every effort to duplicate the seance results by use of a water-filled rubber glove

I do not know any other fraudulent procedure. A Belgian engineer lately told me that he had invented a paraffin sufficiently elastic to allow of a living hand being released from it, but I have in vain invited him to give a demonstration of this. It is, however, of no importance, for we can give a conclusive answer to the sceptical. Let us take for granted that it may be possible to make paraffin molds identical with the super-normal ones by using a normal human hand. Could this process have been used by our medium? We call the close attention of readers to what here follows, for it is the point of the whole question.

Supposing the medium to have found out how to make paraffin gloves artificially, he would have been unable to do this during the séance. He must necessarily have made them beforehand and have brought them in surreptitiously. But we are able to certify that the molds were actually made at the séances. We shall now advance the proofs of both these statements.

The molds, under supposition of fraud, were assuredly not made during the séance. The proofs of this are numerous and decisive. The control rendered all complex and delicate movements impossible. The digital imprints of the casts, scrutinised at the Prefecture of Police by M. Bayle, the highly distinguished chief of the Criminal Identification Service are not the finger prints of the medium. If it be objected that if not the hand of the medium it must be the hand of one of the experimenters, the answer is that we have frequently had the hands of children, when there was no child present and no child could have got into the laboratory.

This last argument is decisive. If there be any fraud, the fraudulent molds must necessarily have been brought from outside. But the molds were not brought from outside. They were made during the séance itself. In order to have mathematical certainty of this, Professor Richet and I decided on two means of control.

The first consisted in coloring our paraffin immediately before the experiment. Our molds all had the exact coloration of the paraffin so prepared in the laboratory. We also decided to mix with the paraffin some substance soluble in it and admitting of chemical test. Herewith the notes of this crucial experiment made December 31, 1920.

After several trials I chose cholesterin. I poured five grams of it into the warm paraffin. I tested, several times, samples of the treated paraffin, for cholesterin, and saw that the reaction was clear. This chemical reaction is well known. It consists in dissolving a little of the paraffin in chloroform and adding sulfuric acid. Slowly and gradually a red color, turning to brown, is produced. Ordinary paraffin without cholesterin gives no color when so treated. We had thus a sure method of verifying whether the molds were made during the experiment with our own paraffin. The testimony of our senses was confirmed with mathematical precision.

The manipulations had been made by myself alone before the sitting, in absolute secrecy. The tank of paraffin was placed on the rectangular table about two feet from the medium. Control of the hands of the medium, complete, several times stated aloud. Very dull red light. Soon we heard the splashing in the paraffin and perceived the successive phases of the operation. When I judged this operation finished, I increased the red light, and we could see on the table two molds still warm. One was the foot of a child, admirably sharp in its outlines, and extending up

(Continued on page 373)

The Animal Hospital

Surgical Treatment for Horses, Cows, Mules, Dogs, Cats, Goats, Canary Birds and So On

By William A. McGarry

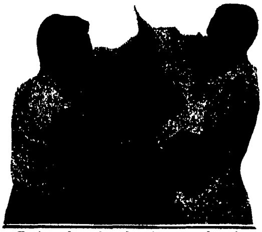
HORSES, cows and mules can now be given surgical treatment for tumors, wounds, laryngitis, ruptures, broken bones, severed tendons, distortions and many internal diseases that formerly made it necessary to shoot them. Such operations are being performed every week day in the year, not only for the purpose of getting information concerning rare diseases that may be of value later in treating human beings, but to save and prolong the lives of the animals and to increase their usefulness. And the same facts apply to dogs, cats and other pets, including rabbits, goats, canary birds, parrots, monkeys and even the pungent skunk. They apply also to barnyard fowl—chickens, geese, ducks and turkeys.

What might be called the other side of the anti-vivisection story was brought to public attention quite recently in Philadelphia by the announcement that there had been set up in the University of Pennsylvania veterinary hospital the first operating table ever built for the accommodation of horses and other large animals. The machine was designed by Dr John W Adams, professor of veterinary surgery and obstetrics at the University and chief operating surgeon at the hospital, which is run in conjunction with the school. It was evolved after several years of experience and after all existing apparatus had been found unadaptable to the peculiar needs of the veterinary surgeon.

The table when not in use looks like a section of iron wall backed by leaning braces. It is oblong, and while standing on its side its width is a little more than the height of the tallest horse. At one end there is a projection to serve as a head rest, and the table is fitted with leather pads to prevent galling, and with straps by which the animal to be operated on may be made fast to it. The procedure when an operation is to be performed is quite simple. The animal is walked to a position beside the table, which stands on its side. He is strapped securely to it and a blindfold is placed over his head. One of the surgical assistants turns a lever that sets in operation an hydraulic apparatus, and the table begins to tilt over, carrying the horse along. In a few seconds the animal is on his side, resting comfortably.

Another assistant then goes to work with the anaesthetic, using exactly the same methods as he would on a human being except that the apparatus is larger and specially designed, and more anaesthetic must be used. In operations on human beings it is customary to start with chloroform and then after the patient has begun to lose consciousness, to use ether. That is done because ether has a sickening effect, although it is not as hard on the heart and therefore not as dangerous. Horses, however, are almost immune to ether. It merely excites them. While it might be possible to render them unconscious by using enough of it, the surgeons prefer chloroform, and a quart of that potent stuff is required as a rule to get a horse ready for the knife.

Total anaesthesia, however, is resorted to only in case of a major operation. When the injury to be treated is local, as in the case of a surface tumor or abscess, procaine, novocaine or some other of the recently developed local anaesthetics are used, and Dobbin never knows that he has been all cut up until long after he has reached his stall, when the effect of the drug is beginning to wear off. When the operation is completed the table is tilted again. In the case of a major operation and total anaesthesia, the apparatus is stopped at an angle of 45 degrees, and a heavy steel hand truck also designed by Dr Adams, is run alongside. The straps are removed and it is then possible to slide the horse on the truck, which is wheeled to his stall. By a system of gears the truck is tilted and the animal slides easily to the floor of his stall with minimum disturbance.



Testing a horse for tubercular germs through the eye

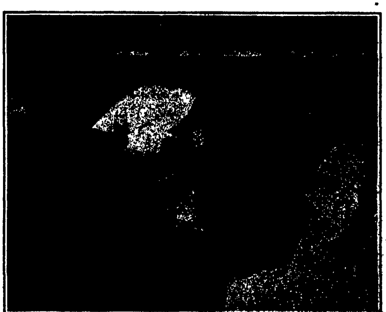
Although this table has been in use only a few weeks, it has proved already to be one of the most valuable adjuncts to veterinary surgery. Heretofore all sorts of expedients were used in serious operations on large animals. Sometimes they were performed while the animal, unconscious, lay on the floor. That made it necessary for the surgeon to kneel. At other times hoisting tackle was used to lift the horse to a table. The danger there lay in the injury that might be done to tissues already weakened by the operation, and various forms of hammocks had been devised. The tilting operating table makes all of these unnecessary.

Students at the Veterinary School of the University of Pennsylvania inspecting cows for tubercular germs

Almost at the same time the table was set up for its first use announcement was made in the newspapers of a marvelous operation by a Viennese surgeon, now on his way to Chicago to continue his experiments. He is said to have succeeded in grafting a complete eye from one animal to another in such a manner that it could see just as well as with its own eye. As a rule, however, stories of experiments on living animals hold forth no such immediate and startling hopes as this. Many of the most important tasks of vivisection are for purposes that are never explained to the public, and hence when reference is made to operations on animals it stirs thoughts of supposed cruelty. That is why the University hospital story tells the other side of the anti-vivisection, for its primary purpose is the health and welfare of the animals it treats.

It was more than 100 years ago that the project of establishing a veterinary school and hospital was first broached at the University. In 1807 the noted Dr. Benjamin Rush made an address before the Philadelphia Society for Promoting Agriculture, urging that steps to be taken in that direction, but nothing was done until 1883, when the school was started. For 40 years the school and hospital has been turning out "animal doctors" and saving the lives of burden and pet animals, but it is only in recent years that its surgeons have succeeded in developing a technique in many respects equal to that achieved by surgeons treating human beings. Twenty-two years ago the University, in cooperation with the State, erected a group of sanitary, fire-proof buildings specially equipped for the treatment and care of ailing animals, and these have been added to from time to time until the hospital is perhaps the finest of its kind in the world.

It is only a few years since it was the practice to shoot a horse or valuable cow or bull which had suffered a broken leg, and in many parts of the country that is still being done. The records of the hospital show 11 cases of fracture treated within a year, six of which were successful. The task is far more difficult than in repairing fractures of human bones, since in nearly every case considerable time elapses before the horse gets treatment, and during that period he often splinters the broken ends of bones and irreparably damages the surrounding tissues. Therefore in five cases it was impossible to save the animal. The operative record for the last calendar year, however, is remarkable. In all there were 274 operations performed, for a myriad of causes. Out of that number 249 were discharged, eight were sent away as inoperable, two died and 15 were destroyed. The list of large animals included 263 horses, eight mules and three cows.



Chloroforming a horse preparatory to an operation. It often requires a full quart to put a horse to sleep

That, however, fails to measure the extent of the service being given to animals by the hospital. It is the record only of the surgical clinic. In addition there is a medical clinic for large animals which treated 1[illegible]1 cases, out of which [illegible] were cured and [illegible] died or were destroyed. In that connection it is of interest to note that the most deadly disease known to horses is comparatively little known to the general public. It is called [illegible], and may be described as a form of [illegible]. According to Dr. [illegible], Director of the Veterinary School, it [illegible] large animals than [illegible] yet it may be prevented with little difficulty. It is always the result of feeding a horse normal rations while he is standing in his stall for two, three or four days, after a

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Squeezing Softwood to Make It Hardwood

RECENTLY there has been developed in Holland an industry which may bring about enormous alterations in the cultivation of hard woods. It has been possible to convert soft woods, by pressing, into hard woods, which present a very good appearance.

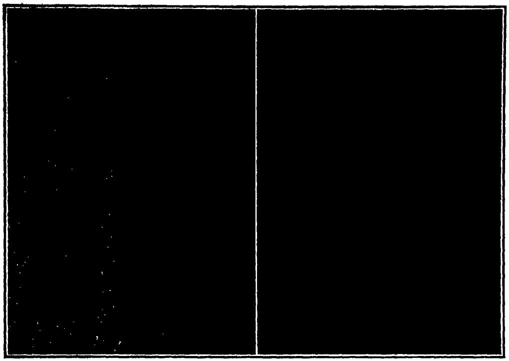
When one looks at a piece of wood in cross section, one finds all kinds of fibers and bundles of fibers enclosing cavities. These cavities are essential for the life of the plant, for they see to the transfer of water and food, as well as to the storage of reserve material. When the plant is dead, however, and the wood is going to be used, then these cavities are an unfavorable circumstance, because they lower the value of the wood. It is then just the quantity of fibers which governs the value. The more cavities there are, with regard to the number of fibers, the softer and more easily split is the wood. It is also a well-known fact that the natural hard woods are characterised by a very small quantity of cavities, compared with the number of fibers. From this it follows directly that as soon as one succeeds in diminishing the amount of cavities in a defined kind of wood, this wood must have better—or harder—properties. Although this idea is self-evident, it has only recently been realised in a technical way

When a piece of wood is subjected to a uniform high pressure, along with a high temperature, the above-mentioned cavities are pressed in and the piece decreases largely in volume. The necessary pressure of about 300 atmospheres must, of course, be applied equally on all sides, and this is best accomplished by using a liquid as the pressure medium. Water is unsuitable, however, for it penetrates into the wood and thereby the pressing effect is lost. A satisfactory medium has been found in asphalt, which only just penetrates into the wood, and then forms such a hard layer, that further penetration is impossible.

A whole tree trunk at one time is placed in an autoclave, dipped under the asphalt, and then subjected at a temperature of 100 deg. C. to a pressure of approximately 300 atmospheres for five hours. The trunk shrinks to about half its original size and greatly increases in hardness. One has to be very attentive and take care that the wood has a definite moisture content, because otherwise cracking takes place. If it is dried too much, the pressed wood begins to swell, as soon as it is brought in contact with moisture. Also, at the high pressure some chemical decomposition reaction takes place, which appears to be necessary for the success of the pressing. With insufficient care a formation of caramel can occur, which causes a darkening in the color

When the wood is pressed, the outer layer, into which the asphalt has penetrated can be sawn off, and then one can cut it up into whatever pieces of lumber are desired. These pieces possess a very beautiful marking, since the layers, already present in the wood, are now much closer together It makes a magnificent shining polish. Up to the present, lignostone, as the product is called, has been chiefly fashioned into golf clubs, loom bobbins, walking sticks, and luxury articles, but especially in the domain of inlaid work does it promise a good future.

It is easy to understand that the natural hard woods in the future may experience a strong competition from lignostone.



Cross sections of a piece of elm, showing (left) the wood in its natural state, with large cells, and (right) compressed to make it lignostone, with hard wood characteristics

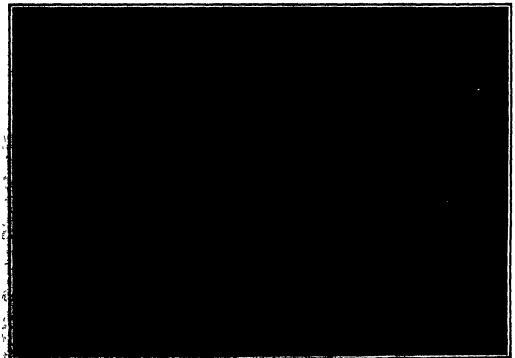
Angelique—A Wood that Resists the Attack of the Teredo

FROM tests recently conducted in Dutch Guiana, it appears that a wood has at last been found which is immune to teredo attack. This wood is Angelique (Dicorynia paraensis Benth.), which is said to owe its teredo-resisting qualities to the presence of fine particles of silica in the fibers, which act as an abrasive on the boring apparatus of the mollusk Physically, Angelique is a dark brown, heavy wood with a specific gravity of 0.851 when freshly cut and 0 746 when thoroughly dry

Angelique was subjected to rigorous tests in the lock gates of the Saramacca Canal, which lies just south of the city of Paramaribo, the capital of Dutch Guiana This waterway connects the Surinam and Saramacca Rivers. The water of the canal is brackish and the local government has experienced great difficulty in maintaining the gates and other timber structures because of the presence of the teredo The gates were originally built of Demerara greenheart, a wood which gained much publicity during the building of the Panama Canal, as it was selected as the best wood known at that time for use in lock gate construction, in waters infested with limnoria It was not long, however, before it became apparent that greenheart was being rapidly destroyed in the Saramacca Canal, and the Dutch Guiana government undertook to find, if possible, a local timber having durable qualities that would baffle the teredo

Among the great number of woods experimented with was the native Angelique which after five years service in a particularly badly infested locality, was, for all practical purposes, found to be free from attack, while the greenheart placed under the same conditions was utterly destroyed within two years

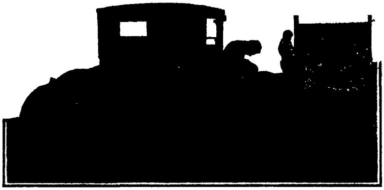
Angelique has been used since 1915 in Dutch Guiana by the local railway company to replace imported teak in the building and maintenance of railway cars. When properly dried it answers the purpose exceptionally well, although it has the disadvantage of being harder to work In all places where toughness and resistance to abrasion are required, it can be safely recommended. Angelique is found in large quantities in the eastern half of the province Specimens six feet in circumference and 60 feet clear bole are common while trees as great as nine feet in circumference and having a full ninety feet of bole are not exceptional



Evidence of the teredo-resisting qualities of Angelique (shown below) compared with greenheart (shown above). Both woods were subjected to five years' immersion in the same locality. The coin is about the size of an American quarter

How to Make Lime Set Quickly

SOME months ago the Bureau of Standards developed a quick-setting lime composed of one volume of ground quicklime and two volumes of hydrate. The commercial success of this material depends upon finding some way to make it keep during shipment, or else to make it into finished form at the factory. Working on this latter phase of the subject the Bureau has been developing a cast lime partition tile Experiments have shown the best composition to be one volume of wood fiber, five of quicklime and ten of hydrate, and that the best curing condition is outdoors exposed to the weather Such a block sets so that it can be removed from the mold in ten minutes, can be handled in twenty minutes, can be sawed and nailed, and has a compressive strength of 100 pounds per square inch at seven days. It is about 20 per cent heavier than gypsum tile of the same size, and experiments are now being conducted to see if the core volume can be increased without too great a sacrifice of strength



The car is placed 25 feet from the test screen that is used to diagnose the ills and evils of headlamps which have gone wrong

Why Headlight Glare?

How Uncle Sam Tested the Headlights on 400 Ordinary Motor Cars and What He Found

By George H. Dacy

According to investigations made latterly by national automotive engineers, the automobile headlights on 19 out of 20 motor cars are defective to the extent that they jeopardize the life and limb of other autoists who meet and pass them. Recently, Uncle Sam's official representatives tested out the headlights of 400 automobiles in the District of Columbia—these cars were very typical of the general run of horseless carriages used throughout the entire country—and found that 95 per cent of them were so imperfect in one way or another as to endanger the safety of the operators and other motor car owners who chanced to meet them on the open highway.

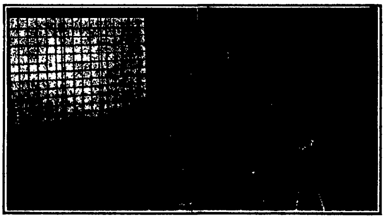
In this day and age when most of the States—where automobile traffic is heaviest—enforce stringent regulations about the design and adjustment of headlights, the fact that in the neighborhood of 19 out of every 20 sets of headlights violate State regulations through the carelessness of the car owners and drivers, is astounding. In the arts and industries, we are constantly reading about the formulation of new safety codes for this or that trade. The resources of science are yoked to the task of taking the doubt and danger out of hazardous occupations. And at the same time, we motorists, as a class, through sheer neglect are promoting a menace in highway travel by forgetting to maintain our automobile lamps in the most serviceable and efficient condition.

The results of the headlight search and research are startling to most of us when we understand that 78.2 per cent of the lamps tested were out of focus. You know how it feels to be driving along a slippery, skiddy pavement some black, rainy night and all of a sudden to have an approaching car almost blind you with its powerful lights whose beams have gone astray due to the neglect of the owner. If the figures are impartially representative—there is every reason to believe that they are—you may expect to be nearly blinded by the unsatisfactory lights of 78.2 out of every 100 motor vehicles that you meet. These facts and figures are astounding enough to keep timid motorists at home stormy nights, when the dangers from improperly adjusted headlights are maximum.

Not only is the man who drives a car with faulty lamps a menace to all those he meets or passes, but he also is a source of danger to himself and the occupants of his car. The lenses of his lamps may be so dirty that they only throw half enough illumination on the roadway—52.8 per cent of the headlights examined were suffering from dirty lenses. As a consequence, the driver may guide his car into the ditch or over a steep embankment just because his lights were so dim that he could not see where he was heading. Of all the cars inspected, 46.7 per cent had headlights that were not correctly tilted. 40 per cent had dirty, rusty or dented reflectors, the lenses in 35.8 per cent of the cars were twisted in the headlamps, while in 23.6 per cent of the cases the headlamps were not parallel.

Dirty lenses and reflectors simply reduce the average efficiency of the headlamps. However, they become dangerous when they do not transmit sufficient light to the roadway to make driving safe. Headlamps that are not parallel are extravagant profligates of light, as rays which should be reflected down the road serve only to illuminate the surrounding scenery. Lack of focus, twisted lenses and lamps tilted upward result in a waste of light and throw a blinding glare in the eyes of the approaching driver. Headlamps that are tilted too far down light the highway for only a short distance in front of the car. They produce a narrow zone of illumination about 80 feet deep extending from 20 to 100 feet ahead of the car, depending on the degree of tilt. When corrected, they should produce a broad zone of light extending from 40 feet in front of the car to 250 feet or more down the road.

Study of the recent survey made of District of Columbia motor cars shows that over one-half of the cars violated the local traffic ordinances due to the fact that their headlights were glaring. In the main, this condition was due to improper adjustment of the lenses. There is absolutely no excuse for such errors of headlamps for it takes only a few minutes of well-directed work to correct them. Increased safety and greater road illumination are the worthwhile results of such activities. Time spent in checking and adjusting headlights probably offers a better return than could be secured from a similar amount of work on any other part of the car, with the possible exception of the brakes. In no one function of automobile maintenances does the



Laboratory test of automobile headlights for optical performance as well as for electrical dimming devices

general driving public require direction and education more than in this simple little matter of lamp upkeep.

The cars were tested for efficiency of illumination by driving them in turn into position about 25 feet from a special screen on which was drawn a horizontal line at the level of the lamp (about 36 inches) and two vertical lines spaced the same distance as the headlamps (about 28 inches). The intersections of these vertical lines with the horizontal lines represented the projection of the centers of the lamps to the screen along a line parallel to the surface on which the car stood. The lamps were focused and the lenses properly pointed so that defects in the position of the lamps could be noted and corrected. When corrected properly, the lamps would throw on the screen oval or elliptical patterns with the long axis horizontal. Light which strikes the horizontal line would never reach a level road. Light falling [illegible] inches below this line hits the roadway about 225 feet ahead while rays striking 18 inches below the line illuminate the highway at a distance of [illegible] feet from the car.

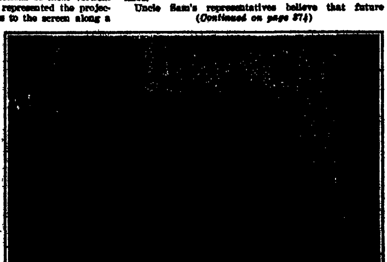
Adequate gutter illumination is secured by light that strikes the screen two feet to the side of the vertical line and nine inches below the horizontal line. In order to obtain some light above the pavement as a protection against overhanging foliage and limbs, the pattern should be so adjusted as to appear slightly above the horizontal line in the center only. A space in the upper left hand sector about five inches above the horizontal and the same distance to the left of the left-hand vertical line intercepts the light which would probably reach the eyes of an approaching driver 100 feet away. This light, if sufficiently intense, is known technically as "glare." Special care must be exercised in adjusting lenses to see that none of the principal beams fall within this sector.

Fifty-seven different makes of headlights divided into three main classes were tested out in the recent Washington survey, the Bureau of Standards experts furnishing their services free of charge to all motorists who desired such assistance. Seventy-two per cent of the cars were outfitted with devices approved by the last Motor Vehicle Administrators Conference; 23.8 were equipped with devices that were of some value but are not on the latest approved lists, while 4.2 per cent of the cars carried devices that were practically worthless because they could not be adjusted to eliminate glare without decreasing road illumination below the limit for safe driving. Despite that good devices were installed on many of the cars, the headlighting was nevertheless defective because only 7 per cent of the best devices were in proper adjustment and over 52 per cent were dangerously glaring. In the second class of devices mentioned above, 55.5 per cent were glaring and only 1 per cent in good adjustment while all the lights in the third class were glaring.

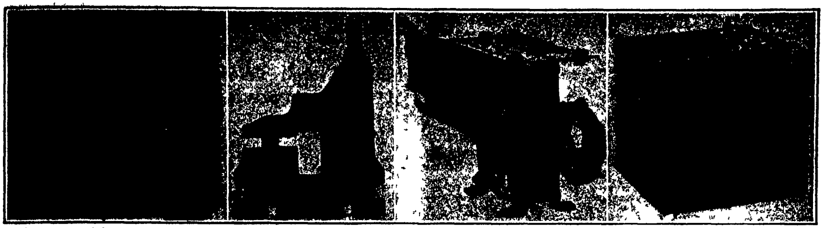
The installation of approved headlight devices on any automobile is merely the initial step in securing safe, legal and adequate road illumination. It is fundamentally important that these contrivances all be maintained in the acme of adjustment if they are to function properly. Frequent and regular inspections are imperative. With the idea of educating the average motorist to the importance of keeping his headlights in proper tune, the Washington Safety Council plans on erecting a number of testing screens in different parts of the City of Chief Executives that will be available to the general motoring public free of charge. Potentially, it is essential that adequate headlight laws be enforced for the protection of the motoring public. At present, so little attention is paid to the proper adjustment of headlamps by the ten million or more motor car owners throughout the country that the traffic courts would be swamped with cases if all the offenders were to be found and fined.

Uncle Sam's representatives believe that future

(Continued on page 374)



Another view of the equipment used in testing automobile headlights. Note the swinging support and the clamps for holding different lenses



Components of the new recharger and its complete assembly First, looking down into the recharger case, with chemical cell at right. Second, the electrode of balkite metal. Third, the transformer and its connections. Fourth, the wooden case, with fins of chemical cell left partly exposed

A Fool-Proof Recharger for Storage Batteries

THERE has lately appeared on the market a new type of storage battery recharger, which now takes its place alongside the vibrating type rectifier and the vacuum tube rectifier, for use in the home and private garage. The latest recharger is a chemical rectifier, complete with step-down transformer and leads, so that it may be readily connected with any 110-volt alternating-current supply

The action of the latest recharger is dependent on an alloy called "balkite," which is a form of the element tantalum The material forms a one-way valve when introduced into certain acid or alkaline electrolytes, allowing one-half of the alternating current wave to pass through it, and completely checking the other half of the wave. In the commercial type the standard storage battery electrolyte is used in order to simplify care and maintenance. Furthermore, the recharger contains a two-winding transformer which allows the recharger to be used during the operation of a radio set, without any danger of blowing out vacuum tubes.

The new recharger is of compact dimensions and neat appearance. A sturdy wooden case contains the transformer and the chemical rectifying cell, and provides space for the battery leads and plug connecting cord. The recharger is virtually fool proof. It is entirely noiseless in operation, while a small red light, which may be viewed through a window in the transformer compartment, indicates when the recharger is working. There is nothing to adjust. It requires no attention except an occasional filling with distilled water It cannot fail to charge the battery, and it cannot discharge the battery even when left connected. It cannot short circuit. It delivers a taper charge which decreases as the battery becomes charged, so that damage through overcharging is impossible.

The writer of these lines has found the recharger satisfactory in every way, after prolonged tests with six-volt storage batteries used for radio work. The electrical efficiency of the recharger varies between 25 and 40 per cent, depending upon conditions. This efficiency, in view of the simplicity and thorough reliability of the recharger, is ample. Tests on leakage indicate that the recharger may remain attached to the battery without danger of discharging it. The chemical valve will stand a back pressure of 200 volts before it allows current to flow through in the wrong direction.

A leading storage battery manufacturer has recently incorporated this recharger in a compact unit together with a storage battery. Thus in a single wooden case, the radio amateur is ensured a reliable source of filament current or plate current, or both, without the usual multiplicity of apparatus and the bother of connecting up.

Electric Heat for the Type-Metal Pot

IT is well known that all linotypes, intertypes, monotypes and other forms of type-setting and type-casting machines have melting pots in which the type metal is kept molten through the application and maintenance of sufficient heat However, it is not generally known that the heat must be just so for satisfactory type casting, and that it must be maintained at such critical temperature within very narrow limits.

Gas is ordinarily used for the purpose Electricity, which has been gaining more and more ground of late years, is considered a decided improvement on gas. On its face it would seem to be the real solution of an even source of heat, but in actuality there are several troublesome factors that insist on popping up One of these is line-voltage fluctuation, which causes a marked fluctuation in the type metal temperature and consistency, thus hampering the operation of the type-casting device. The average electrically heated metal pot requires anywhere from 2,000 to 2,800 watts of energy, which is a strain on the average electric light circuit.

The latest developments in this field take the form of the equipment shown in the accompanying views. A vibration thermometer is incorporated, in which the distance of travel of the pointer has been limited to one-eighth inch The pointer is held constantly under spring tension against the positive contact As the heat increases, the pressure against the pointer is built up until the spring tension is overcome and the needle snaps positively from one contact to the other In cooling, the reverse operation takes place This positive action insures perfect contact and the sensitivity of the needle is increased the more the machine vibrates. The actual contact end of the needle is a loose roller which must travel around a high point in moving from contact to contact. This automatically turns the roller on the spindle, and presents a cleanly scraped contact surface to each movement This thermostatic control insures a temperature regulation of 25 degrees on the operating machine, and 80 degrees on the idle machine

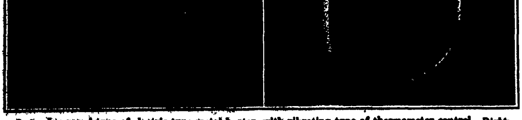
A chemical investigation made at Columbia University proved that there is a critical temperature of type metal. Between the limits of 750 degrees and 1000 degrees F., and increasing directly as the antimony content increases and also increasing directly as the temperature increases, there is a very decided action of the antimony on iron The affinity of antimony for iron causes great activity of these two metals within these limits. The cleanly finished surface of iron or steel will be attacked at once, and in the case of thin sheeting the walls will be penetrated

This was exactly the case of the immersed heating unit The units were made of channel iron and presented an ideal surface for this action. The space between the heaters and the walls of the crucible would gradually become clogged with dross which acts as a heat insulator The temperature of the metal in this space was naturally higher because the outside heater was also radiating heat in this direction This natural, excessive temperature was very much increased by the above-mentioned accumulation of the dross insulator, which hampered the conductivity of heat from the unit itself

The melting point of tin is 446 degrees F., lead 620 degrees, and antimony 1150 degrees. When these metals are mixed, the melting point of antimony is lowered considerably As the temperature of the metal increases to 800 degrees and above, the tin element as well as the lead element is gradually burned out to a certain extent As the melting point of antimony is much higher, it is burned out more slowly The result is that the proportionate percentage of antimony is increased as the percentage of the other elements is decreased The very high temperature in the space between immersed heaters and crucible walls foster this condition. The increasing percentage of antimony and the excessive local temperature of the mixture set up the most satisfactory conditions for the chemical action of the antimony on the iron channel shell This shell, therefore, has often been attacked, penetrated, the metal seeped in and the unit was short-circuited.

In the course of scientific research to establish the action of antimony on iron, it was also necessary to find an element which hindered this action Of all those tried, the most effective and most economical was found to be the scaly surface on iron castings. If this surface was penetrated by filing or machining, the action was the same

The nichrome wire heaters were inclosed in drawn steel tubes. It was necessary to manufacture these tubular units so that they could be immersed in molten iron at 2300 degrees F., and allowed to remain there until solidification without fear of melting. The danger of explosion, due to moisture within the tube, was also acute The manufacture of suitable units has now been successfully accomplished and the tubular heaters are covered by not less than one-eighth inch of cast iron It is impossible for the antimony to penetrate this construction and the heating of the type metal is at its best

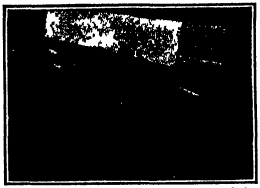


Left: Improved type of electric type metal heater, with vibrating type of thermometer control. *Right:* Internal details of the vibrating thermometer

Righting a Capsized Ship

Successful Righting and Setting Afloat of the Brazilian Steamship "Avare" in Hamburg Harbor

By Dr. M. Probst
Marine Engineer



A few of the pulling winches within the pier shed

WHEN the Brazilian passenger steamer 'Avare' was leaving the dock last year with double bottom tanks only partially filled she capsized for want of sufficient stability and caused the loss of 39 human lives. In its wrecked position the ship which was lying between two piers was a big obstacle to shipping. A quick salvaging operation therefore was demanded in the interests both of the owners and of the Harbor Authorities.

The vessel with a tonnage of 8227, has a length of 418 feet a breadth of 56 feet and a depth of 38 feet. She was formerly owned by the North German Lloyd under the name Sierra Salvada but by the Peace Treaty of Versailles she was transferred to the Brazilian Government. The Vulcan Works of Hamburg undertook the salvaging work their large shipbuilding yards being situated very near to the place of the accident.

The distance between ship and land being only 300 feet the salvaging was practically a simple matter the method adopted having often been practised on smaller boats with some greater complications also on the German liner 'Gneisenau' sunk 1914 and salvaged 1917 in the River Schelde near Antwerp and on the American passenger ship 'St Paul' which capsized and was salvaged in New York Harbor. This was done by raising about 12 triangular trestles on the port side of the hull which was strengthened by longitudinal girders. Then these trestles were connected by means of tackles to fixed points on the pier consisting of driven piles. The tackles were then pulled by steam winches until the ship was righted. After being righted the ship could be ballasted refloated and towed to the dock.

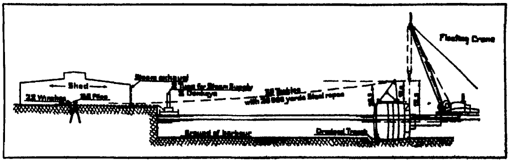
In spite of the simplicity of this method, extensive preparations were required on the part of the shipyard and her contractors. Trestles 35 feet high were constructed riveted and erected on board by means of the Vulcan's large floating crane. As the structural material for this work could be taken from the yard's stock the whole work was finished within a few weeks. All the trestles were connected by horizontals and diagonals forming a rigid framework.

At the same time large piles were driven into the sand bottom of the quay shed by means of two steam drivers used for building work. Altogether, 182 piles of 35 feet length and 18 inches diameter were required. They were driven in groups of four or six, forming 30 fixed points for the 30 tackles, each of 40 or 60 tons pulling power. The total pulling power was estimated at 1320 tons.

Within the short time at disposal it was rather difficult to assemble the necessary lengths of steel ropes, the whole length of which had to be 20 000 yards. With less difficulty the required steam winches were produced for on account of the restricted space disposable in the shed no more than 22 winches could be placed there. There were also eight floating winches, each with its own boiler on board. These were moved to the quay below the main tackles.

It was also an important factor to have an adequate supply of steam for the winches on land. Therefore, two large tugs containing 10,500 square feet heating surface were disposed as close as possible to the main winches and from the tugs steam pipes of six inches diameter connected by flexible hoses were conducted to the battery of winches. Similarly exhaust pipes were arranged parallel to the supply pipes, exhausting out of the shed upwards into the open air.

The capsized "Avare," with 12 steel trestles erected upon her side for attachment of the pulling cables



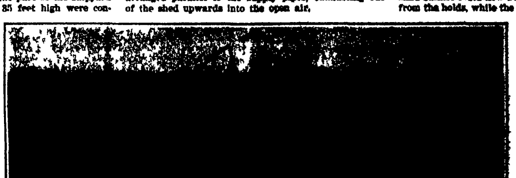
This shows, left to right, the pulling winches in the pier shed, the cables, the capsized ship with the steel trestles erected on her side, and the floating crane

In spite of the difficulty of working under water, the holds of the ship below the third deck were made nearly watertight and partially sounded by powerful pumps on board of the salvage barges. The weight to be lifted was by this means reduced. A further diminishing of the required righting moment was gained by dredging a trench below the starboard bilge keel, so that the center of rotation was displaced about seven feet nearer to the center of gravity.

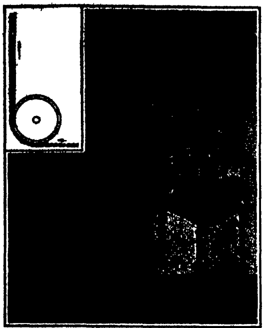
As a considerable reserve of lifting power for the first and hardest period of lifting, four salvage barges and the floating crane of the Vulcan shipyard were moved to the deck side of the capsized vessel. These exerted a lift of 800 tons. The total turning moment, realised with the described means, was 185,000 foot-tons.

Near the middle of August all the preparations were finished, and the navigable water, hitherto used by shipping was shut off, preparatory to stretching the steel ropes of the tackles between ship and land. The valves on the steam pipes leading from the tugs were opened, the winches tested, and the steel ropes gradually pulled taut. On the morning of August 16 the holds of the ship were drained as much as possible by pumping, the lifting tackles of crane and barges were also pulled taut and then, on a blast signal, all the barges, donkeys and winches began to pull at full power. In a short time a small lifting of the ship was observed the winches continued turning and inch by inch the superstructure was raised out of the water. The turning was continued without interruption until the inclination of the ship was 18 degrees, the hull having been turned through 72 degrees. When this angle was reached the work was stopped the first stage of salvaging being finished. After being righted the 'Avare' was made fully watertight and prepared for pumping out. But the most important point was the stabilisation of the ship, to prevent a repetition of the capsizing at the moment when the weight of the hull would be diminished by pumping to the point of flotation. Therefore a large quantity of sand ballast was brought on board and distributed in the holds, with the result that the list of the ship was further decreased. All the water above the sand ballast could now be removed by pumping, at least from the holds, while the engine rooms were left flooded until the other compartments were emptied.

On September 7th this ballasting and pumpwork was finished and ultimately the engine and boiler rooms were pumped out, until the ship began to get afloat. On a displacement of 15,800 tons, with a draft of 30 feet, the "Avare" was towed into the largest floating dock of the Vulcan Works, where the salvaging was successfully finished. All this work was done in ten weeks, at a cost of no more than 7½ per cent of the initial cost of the ship.



The ship partly righted, ready for the final pumping and floating



A belt-conveyor for messages which works on a novel principle

Something Different in Belt Conveyors

OF decidedly unusual design is the belt conveyor recently installed in the Berlin trunk line telephone exchange. It takes the place of the flat-tube pneumatic mail installations formerly in use for the transmission of order slips. The new belt conveyor comprises a belt passing along the trunk line record tables and is based on the fact that the friction coefficient of paper on metal is only half as much as that of paper on textile fabric. The order bulletin is slipped between the traveling belt and a plate of sheet metal serving to guide it and, on account of the greater friction, adheres to and moves along with the belt. Inasmuch as the same scheme would seem to lend itself to many other applications in connection with the conveyance of large quantities of letters, slips and other light objects, it is of more than passing interest.

The essential idea of the new belt conveyor is made clear by the drawing which shows the woven belt, the sheet metal guide, the letters or slips of paper, and a pulley. Part of a typical installation is shown with ups and downs and sharp curves to demonstrate the flexibility of the system, as well as the electric motor drive. It will be understood that the belt does not have to be continuous. An ingenious mechanical arrangement permits of transferring messages or letters from one belt to another, and there is even a possibility of guiding the traffic through angles of less or more than 90 degrees by providing an auxiliary pulley which, by means of sheet metal plates, connects the two belt sections. In the case of paper slips of constant size the belt should preferably be adapted to the width of the paper. The paper slips or other light objects conveyed by the belt are, at the opposite end, discharged over a pulley into a hopper.

This ingenious German system has some advantages over the usual message-conveying systems now in use. Its simplicity and low cost are, of course, the main advantages, while the ease with which it turns corners and climbs up or goes down makes it more flexible than a plain belt conveyor found in some telegraph offices.

A new machine which may revolutionize the codfishing industry

The World's Largest Gasket

A CHICAGO manufacturer of gaskets has, it is claimed, made a larger gasket than any in the world, and as this concern is the largest gasket manufacturer in the world such a consummation is quite fitting. Measuring 10 feet 9¾ inches in diameter on the inside and a full 11 feet in its greatest diameter this mammoth gasket required, in order that it might to best advantage be posed for a photograph, the support of three men, one standing well up on a lofty step ladder two mounted on high office stools. Such a gasket must be handled with care and if shipped without dissection or bending would require a good bit of a freight car.

Directive Radio Transmission on a Wave-Length of 10 Meters

UNTIL recently radio communication was for the most part carried on from a transmitting station to one receiving station, that is, it was point-to-point communication. There were only a few special kinds of service, such as time and weather signals, which were transmitted from a sending station to any considerable number of receiving stations. However, even in the case of 'point to point' communication radio signals were sent out in every direction and could, if desired, be received by any station within a certain distance regardless of its position with respect to the transmitting station. Since the total number of messages sent was small, a comparatively small number of wave lengths was sufficient to take care of traffic requirements. With the development of radiotelephone transmitting apparatus, the broadcasting of voice or music by radio has assumed an important position and the waves used in this work occupy a wider band of wave lengths than the sharp waves used for radio telegraph signals. With the greatly increased traffic and the much wider band of wave lengths which it occupies, considerable interference has developed among broadcasting stations and between broadcasting stations and radiotelegraph stations.

There are two ways of reducing such interference. To direct the waves from the transmitting station in a narrow beam toward the receiving station and to employ in such transmission shorter wave lengths than have heretofore been used. In England investigations have been made of directive short wave transmission and at the Bureau of Standards experiments have been conducted on transmitting apparatus employing electron tubes which transmits a directed beam of radio waves and employs waves as short as 10 meters. In these experiments a reflector has been used consisting of short parallel, vertical wires arranged on a frame shaped like a parabola or reflector functioning in much the same way as the mirror for light waves. Forty vertical wires were used and the generating set with its small antenna was placed in the focus of the parabola, each wire was tuned separately to 10 meters by adjusting its length, and it was found that about 75 per cent of the radiated energy could be confined within an angle of approximately 75 degrees.

This apparatus is described in Scientific Paper of the Bureau of Standards No. 467 and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy.

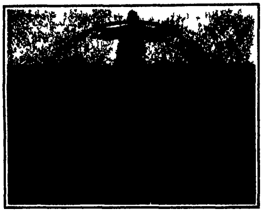
Fatigue Tests of Limestone

AS noted last month the Bureau of Standards is carrying out a series of tests to determine to what extent stone will fatigue under a continuous load. The specimens are prepared in the form of beams which are supported at the ends and have a load suspended from the center which is calculated to give a stress in the stone equivalent to two-thirds of the ultimate strength. Deflection measurements are being made at intervals to determine if there is a continuous sagging, which, apparently, is the case according to measurements which have been made to date.

Dressing a Codfish Every Second

OUT on the foggy Grand Banks the most arduous task of the cod fisherman is 'dressing down.' Everyone dreads it, for it means working regardless of hours until the job is done. If the catch has been heavy, midnight, or even the dawn following, sees the entire crew hard at it by the light of flares. No one, not even the cook, commonly known while afloat as "the Doctor," may have any respite. The deck is slippery with parts of the thousands of cod that have been slid from the knife of the splitters into the hold. Cut fingers are of no avail as an excuse for laying off.

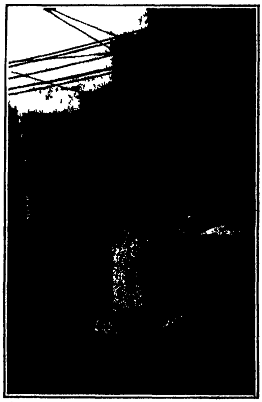
Power has taken a lot of the meanness out of life at sea and the same little gasoline engine that hoists the sails and weighs the anchor will now have more to do—and the crew, less. The 'Iron Splitter" does the work of 60 to 75 men who now wield sharp knives on the Grand Banks off Newfoundland, up along the Labrador as well as in the localities frequented by fishermen from France, England and Scandinavia. Every second the new machine takes a fresh codfish and as often it turns out a dressed fish. It performs all the usual operations of splitting, removing the backbones, cleaning and washing. This ingenious machine was perfected in Seattle, Washington, by the company which perfected in 1905, a somewhat similar machine called by fishermen "The Iron Chink" because it took the place of thousands of Chinese who were formerly employed to clean fish in the salmon canneries of the North Pacific.



An eleven-foot metallic gasket

More "Talking Lamps"

MOTORISTS who pass through Yonkers, N. Y., at night will find a device installed at the intersection of five principal streets which not only enables one policeman to control the heavy motor and street car traffic at a congested point but controls it better than several officers who were formerly stationed at this intersection were able to do. In the photograph the three beacons nearest the camera revolve while the one furthest away is stationary. Beside the latter stands the single traffic officer whose duty it is to control the entire group of beacons. By pushing a button on the side of the distant beacon he simultaneously revolves the other three beacons, each of which bears the usual "Go" and "Stop" as well as the corresponding green and red lights for night signaling. In addition to these signals there is a gong in each beacon which automatically rings as the top turns, thus giving an audible as well as a visible signal.



A remarkable group of four traffic beacons which is controlled by a single officer

Improving Irish Linen

SINCE almost a century the world has been dependent upon Russia for the flax from which it makes linen. A minor portion has, however, come from Belgium, Holland, France and Ireland Americans, mostly unaccustomed to observing the culture of flax, and therefore unfamiliar with the great source of this valuable fiber naturally associate flax with Ireland, for Irish linen figures in literature, and the words "genuine Irish linen," when applied to tablecloths and napkins connote high quality

Ireland is trying to improve the quality of her linen still further by improving the flax plant from which it is obtained. This is quite the opposite of the trend of flax quality in Russia, the giant of the flax industry, at least in quantity of production. For Russia's flax has deteriorated Russia was satisfied. Peasant labor was cheap and there was plenty of it And was abundant—one thinks of Russia as a vast expanse of land, the cities only secondary Ireland was put to it to compete, for land in Ireland is scarce There a nobleman's estate, kept primarily for hunting during a few weeks of the year, might monopolize as much land as a hundred peasants would need in order to support themselves in simple comfort by raising flax. Even barren, rocky hillsides have been literally carpeted with a layer of land laboriously lugged up the slopes in baskets on the backs of patient peasants. How could Ireland, thus handicapped, compete with boundless Russia? By raising not more, but better, flax.

And so while the Russian neglects the evolution of new strains of flax fiber the Irishman organizes the Irish Linen Research Institute at Belfast. Even before the Great War, during a decade the Russian yield had been dwindling, yet so great was the remaining total production there that flax could actually be sold to the Irish linen manufacturers at about $175 per ton. Is it, then, a wonder that the rent-racked Irish farmers, facing such competition, gradually gave up growing the crop? Instead of 100,000 acres their acreage has fallen to 80,000

Today, of course, Russia exports but a fifth of her hundred thousand tons of flax to Ireland of the pre-war days. By this lopping off of the Russian supply the price has been boosted to about $250 per ton.

How, then, to make flax growing profitable to the Irish farmers, and thus to encourage its production by them, is the problem which the Irish Linen Research Institute is tackling. At the outset, two main remedies suggest themselves—improving the yield of flax per acre and improving the quality of the fiber for spinning.

In order to increase the yield per acre efforts are being made to grow more flax plants per acre, to increase the size of the individual flax plants and to increase the proportion of available fiber in the plant itself

One apparently simple way to grow more plants per acre is to sow more seed. Nature rebels—the plants resulting are spindling. Therefore Mr Searle, the research botanist of the Institute, concludes that the result must be accomplished by breeding taller plants. Simultaneously the plant breeder will work for a larger proportion of spinnable fiber per stem.

If genius is the art of taking pains the work done at the Research Institute is genius spelt in capitals. Early in the month of May six to eight thousand seeds are put down, each carefully planted singly and on six-inch centers, each way. When the stems reach a length of nine inches each is tied up to a cane. Later, when the flower appears each single plant is examined, its blossom is removed, and in order to prevent cross-pollination an oiled paper bag is placed over it. Thirty-five days later the plants are pulled.

Now the plants are studied and records are compiled from measurements of the length of the stem, the length of the unbranched part of the stem, its diameter, and the extent to which it has side branches. Portions of every one of the stems are imbedded in wax and 120 cross-sections are cut from each portion. These are magnified 5000 times and the area of the individual fibers is estimated by the planimeter. The number of individual fibers in each bunch is counted. From these and other data what is called the "coefficient of correlation" for each plant is found. This gives an index of the chance of securing an improvement in the strain by breeding this plant with others.

So far the work has been successful. There has been evolved the "John W Stewart" pedigree flax which yields 100 per cent more than that grown from commercial seed. This is true both of quantity of yield and quality of the fiber Instead of about 350 pounds of flax per acre, the farmer will have, with the same cost of production, over 700 pounds. Applied to Ireland's last season's flax crop this would represent an increased return of about $3,500,000. Furthermore, the spinners and the weavers are delighted by the immensely better quality and quantity available for making linen.

Better flax, together with better methods of retting, are bound to bring up the volume of the Irish linen industry.

When Our Teeth are Out of Gear

PYORRHEA is the most talked about dental disease The older people have it and the younger folks are afraid they will get it Although the term pyorrhea alveolaris is a misnomer, yet so many people are acquainted with the nomenclature, that in order to avoid confusion it will be allowed to remain in this article

Contrary to general opinion, pyorrhea is not inherited. We inherit types and forms of teeth, and types and forms of jaws. We might also inherit the manner in which teeth are so set in the bones as to be conducive to the formation of a periodontal lesion. The cause is local to every affected region About 90 per cent of the cases of pyorrhea result from traumatic injury This injury results from the packing of food between the teeth, from the lack of proper mouth sanitation, from injury to the tissues by the use of tooth picks, and from injury because of traumatic occlusion of the teeth

Traumatic injury which results from the packing of food between the teeth is due partly to negligence on the part of the patient in not having proper dental operations made to preclude the food from leaking or packing between the teeth, and partly to oversight on the part of the dental operator in not making fillings which will prohibit such injury This sort of injury, coupled with lack of dental cleanliness, argues well for a speedy loss of the teeth from a pyorrheal invasion

When the patient's attention is directed to the injury received by the vicious tooth pick habit, that habit is generally corrected

One can unseat a nail driven into a board, or a post driven into the ground, by striking either near the top or from side to side. This misapplied force is what also happens to the teeth when traumatic occlusion is continued for an indefinite time. The teeth are literally chewed out of their sockets.

The teeth may not erupt in a harmonious occlusion A slight irregularity might throw the entire occlusal plane out of a normal occlusion.

The most potent factor in the production of a periodontal complication is the occlusal wears of the teeth The occlusal surfaces of the teeth wear into odd and peculiar shapes during mastication Sometimes grinding the teeth during sleep has an untoward influence upon their surrounding tissues When this wear continues for an indefinite time the teeth are worn into grooves and high points. When these irregular occlusal wears have taken place, a greater mechanical leverage is then obtained outside the jaw and the teeth are easily forced from one side of their sockets to the other This tooth movement breaks down the bone surrounding the roots of the teeth receiving the uneven stress. The great force and shock incident to the rubbing or grinding the teeth together causes a traumatic injury to the membranes surrounding the roots of the teeth which results in their absorption, and finally in a loss of the teeth

Frequently a case of pyorrhea is oberved in a patient who has no cavities and few or no fillings An X ray examination, however, discloses the fact that an absorption of bone has taken place to such an extent that treatment will be productive of no good or lasting result The patient in most cases does not recognize that such a bad condition is present until the teeth are loose. It is almost too late then to begin treatment. This destruction of bone surrounding the teeth is caused by a traumatic occlusion.

After the X ray examination has disclosed the true condition of the mouth, the operator decides what teeth, if any, should be extracted. After extraction he proceeds skillfully to reshape all the remaining teeth The high irregular points on the occlusal surfaces of the teeth should be ground or polished off, the operator simultaneously widening the narrow constricted fissures until there is a free easy condyle movement during mastication. The teeth must mesh correctly. The teeth must be reshaped until there is a harmonious contact of the teeth of the one jaw with the teeth of the opposing jaw, that is, they must mesh properly as in the case of gears.

The reshaping of the teeth, together with the obliteration of pus pockets, coupled with oral cleanliness, will generally subdue most pyorrheal lesions, provided treatment has been instituted early enough

Investigation of Orifice Gas Meters

FOR several months the Bureau of Standards has had under way the preliminary arrangements for an investigation of the performance of orifice meters. Certain special equipment, such as large sized air compressors, cooling coils, receivers, test lines (made of extra heavy piping), besides indicating instruments are necessary to carry out work of this character, and it has been largely because of the excellent facilities offered to the Bureau of Standards by the War Department at Edgewood Arsenal, Edgewood, Maryland, that the taking up of this investigation has been possible The present investigation has been limited to a study of the orifice meter of the type used in the commercial measuring of gas. The principal problem of the investigation is to determine the discharge coefficient under all the variable circumstances which may occur within the range of commercial or engineering practice.

In order to solve this problem it will be necessary to make a careful study of the effect of the following variables upon the discharge coefficient (1) The shape of the orifice, which may vary from a sharp-edge hole in a thin diaphragm to a long flow nozzle; (2) the diameters of the pipe and orifice, i.e., the size and area ratio of the orifice; (3) the location, size, and finish of the pressure taps; (4) the length of straight pipe on each side of the orifice or the nature of the fitting or obstructions near the orifice, (5) the linear speed through the orifice or the rate of flow; (6) the absolute pressure in the line and the magnitude of the differential, (7) the density, viscosity, and specific heat ratio of the gas and its deviation from Boyle's law; and (8) steadiness or pulsation of the flow.

The set-up as now arranged will permit the study with air of points Nos. 1 to 6, as enumerated above, through a wide range of conditions. It may be possible to give special attention to item No. 8. It is hoped that when this work is completed it will be possible to make experiments using natural gas or other gases for the investigation of point No. 7

Up to the present time only a few preliminary runs have been made. During these runs approximate checks were made of the discharge coefficient of the flow nozzles which are to be used in the final measurements. These runs have also served to bring out defects in the equipment and have thus furnished a basis for making alterations and improvements.

A Versatile Motorcraft

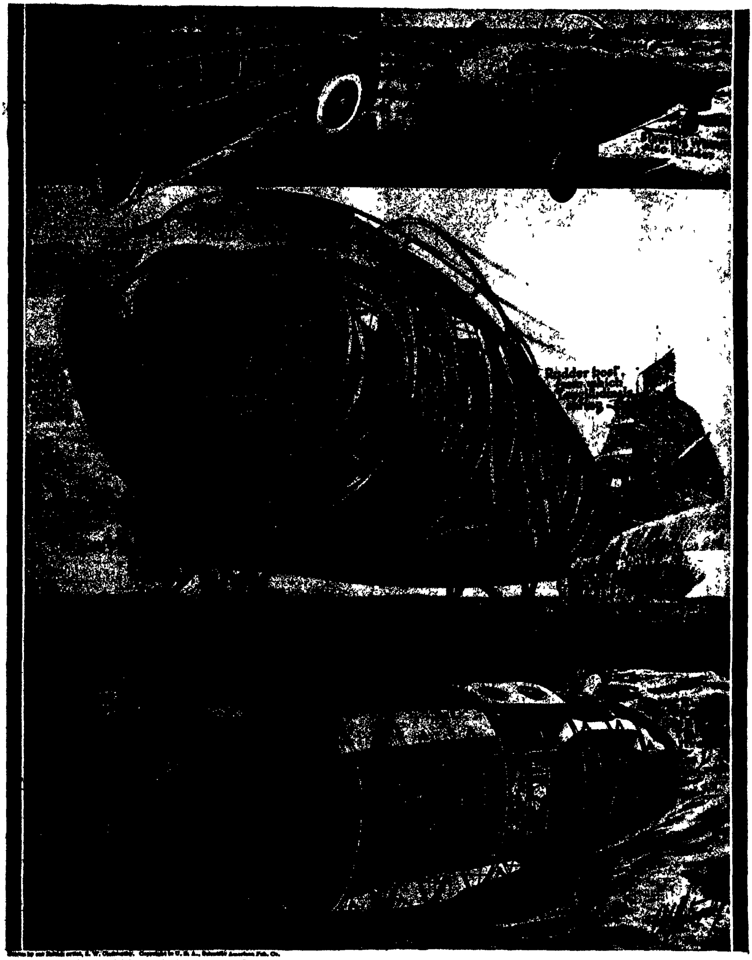
PROBABLY the most interesting object seen by the delegation of American foundrymen during their visit to the Shipping, Engineering and Machinery Exhibition in London last September is a remarkable new speed boat designed by Mr. Green of aero engine fame. This peculiar craft goes one better than the skimming boat in that it rises completely from the water, thus eliminating the skin friction occasioned by planing upon hydroplanes which are almost at the surface. When the speed reaches 70 knots only the propeller and the tip of the rudder remain immersed in the water

The construction of this hybrid craft is revolutionary, combining great strength with extreme lightness, and somewhat resembling airplane work. Around a skeleton consisting of four tubes extending from end to end is placed a series of hoops made from angle iron curved in a tire-bending machine. In place of the customary rib frames the hoops are held together by spokes similar to those of bicycle wheels.

On the facing page are shown two modifications of the same fundamental structure. At the left is a racing motor car in which body and chassis are one. The design lends itself to fine streamlining. At the right is, not a new one-man submarine, but an amphibian with airscrew drive, shown in the act of leaving the water

At the bottom is a ship's lifeboat capable of being launched, with hatch closed, in any position. Canvas seats are snugly fitted between the hoop frames.

The large hull shown in the center picture was tested, after completion, by supporting it solely at the extremities. The actual deflexion at the center of her 40-foot length was found to be but one-eighth of an inch. Each spoke of the hoops has right-angled heads fitted into key-hole slots and divided and joined at the center by a sleeve turning on right and left handed threads on the respective sections of the spoke. Thus, by attaching to the screwbolts at nose and stern the entire structures can be braced and made a unit.



QUEER STREAM-LINED CRAFT THAT MAY BE USED AS A HYDRO-PLANE, RACING AUTOMOBILE, AMPHIBIOUS BOAT, OR NON-SINKABLE LIFEBOAT.—(See facing page for description)

With the Men Who Fly—II

How the Glider Flights of German Students Have Brought About a New Era in Aeronautics

By Alexander Klemin

Lecturer on Aeronautics, New York University

DURING the war, in the desperate struggle for air supremacy, the most direct method of beating the enemy was to have more speed and climb secured by the use of greater and greater engine power, in other words, by brute force. This tendency persisted for several years after the end of the war. It is true that there has been improvement in wing sections, in the aerodynamic cleaning-up of wing trusses, in the careful fairing of bodies and projecting parts, in the introduction of wing radiators which do away with the resistance of the ordinary automobile type radiator. But enormously high powered machines are still used, a single-seater fighter being commonly equipped with 300 to 400 horsepower. This tendency unavoidably reacts on the design of commercial planes, with high power and large gasoline consumption, retarding commercially the profitable application of aircraft.

Aviation History Repeats Itself—Gliding Flights

But while the United States, Britain and France continued in peacetime to develop their airplanes in the same direction, the Germans, forbidden by the International Allied Commission of Control to build high-powered planes, made an extensive study of the more subtle art of gliding. This enforced specialization may be a tremendous boon for aviation, as it may pave the way for low-powered planes and mark a new era in airplane construction.

Often hampered by lack of funds, working under extreme difficulties, German builders had the advantage of cooperation by their universities, and rapidly developed both wonderful machines and skilled glider pilots. German pilots achieved a truly remarkable control over their machines, actually describing figure "8" flights and other evolutions in motorless flight, and for a long time the German pilot Hentzen held the world's duration record for gliding of 3 hours 6 minutes, until this was beaten by the Frenchman Maneyrol at the Lewes meet in England, October 21, 1922, when he remained aloft for 3 hours 37 minutes. Since then the former allies have kept the lead and the world's duration record is at present held by the famous French pilot, Georges Barbot, who at a meet at Biskra, Algiers, stayed aloft for 8 hours 5 minutes. Among other interesting achievements Fokker, the famous Dutch designer, has kept aloft for 13 minutes, carrying a passenger, and an English pilot, G. R. Olley, soared with a passenger for 40 minutes at the same Lewes meet. In the United States, Glenn H. Curtiss, one of the early pioneers of the airplane, built a miniature flying boat with which he has achieved a number of short glides, when released from the towing rope of a fast motor boat. It is ultimately hoped to develop this form of gliding to the point where the crest of a wave may be a sufficient eminence for the start of a glide. At present, being towed behind a motor boat and cutting loose provides a thrilling sport with very little danger.

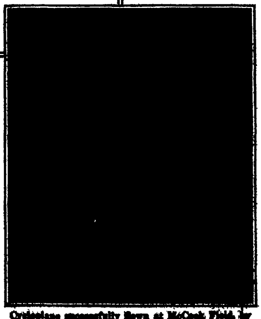
The question naturally arises whether these remarkable duration flights are a mystery; whether we are approaching the soaring power of birds and shall ultimately be able to fly from point to point at will without the use of power. The answer is that there is no particular mystery about gliding, that it follows the ordinary laws of aerodynamics, that duration gliding is a question of good meteorological conditions and a good machine suitably controlled. While under perfect conditions duration gliding is limited only by the physical endurance of the pilot, gliding from point to point at will is not yet in sight, although it is theoretically possible by utilizing the internal energy of the wind.

The principles of gliding are fairly simple. In still air, the glider must have a certain forward velocity so that the wings give the necessary sustentation or lift. In achieving this forward velocity the resistance of the air acts on the wings and the rest of the glider, and absorbs energy. This energy is supplied by gravity. In other words, the glider must lose altitude to sustain its gliding flight, and flight is not horizontal as in the case of a machine where resistance is overcome by the power of the motor acting through the propeller, but on a downwardly inclined path. In a good glider the resistance of the wings and of the rest of the machine is reduced to the minimum, the least possible energy is lost and the glide is a gentle one. In the first gliders such as those used by the Wrights the glide path was one in five or six. In the best German gliders the glide path is one in sixteen, or, in other words, in a glide of 16 feet only one foot altitude is lost. This shows what tremendous progress has been achieved in diminishing the resistance of gliders, and also of airplanes, which are nothing but powered gliders from one point of view.

IN the October issue Mr. Alexander Klemin gave us a broad survey of the coast-to-coast flights and their lesson, the extraordinary advances in engine design, and the steady progress toward night flying, all of which comprised the first article of this series. In the present article Mr. Klemin, who is a recognized authority in the broad field of aeronautics, reviews the progress in gliding flight and speculates on its importance in airplane design. This article was to conclude the series, but so great has been the activity in aeronautics during the past month or two, that we have asked Mr. Klemin to write a third article which, unless aeronautical progress keeps up at its present brisk pace, will complete his review of recent events and their significance.—THE EDITOR.

But this is speaking of gliding downwards and does not explain how flight is maintained indefinitely. However good the glide path, the machine will ultimately reach the ground, unless there is a *rising current of air*. The rising current of air supplies the energy which must otherwise be obtained from the action of gravity by losing altitude.

The skill of the glider pilot is in finding a terrain where there is an upward current of air to supply this energy. When the rising current fails, the aerodynamically clean machine loses little altitude, and the pilot, by a species of flare, so maneuvers his machine that he promptly finds the rising current which may sustain him or even give him greater altitude. And we see that skilled pilots on modern gliders seem to be able to sustain themselves indefinitely in this manner. Gliding is not dissimilar from sailing, where great skill must be used to utilize favorable winds.



Cycleplane successfully flown at McCook Field by foot power. Above: One of the aviation rotating beacons for night flying

But if the glider is no mystery, if duration flight only and not flight from point to point has thus far been achieved—if at present it is but a fascinating sport, gliding flight has great usefulness in both scientific and practical aviation.

In the construction and design of experimental airplanes, the glider may serve as a most useful adjunct. It is extremely expensive and disappointing to build a large airplane and find its aerodynamic efficiency or control to be poor. The glider may furnish a ready and cheap method of experimentation with lessons directly applicable to the powered machine. Efficiency, stability and control may all be studied out cheaply and quickly in this manner.

What Aviation Learns Through Gliding Flights

But besides being a possible adjunct to the testing of experimental airplanes, the glider *per se* will forward the aerodynamic efficiency of airplanes in general. The efficiency of an airplane is inversely proportional to the gliding angle or inclination of the glide path. In other words, the more gentle the glide path of an airplane, the less the power required to pull it through the air. Gliding paths of commercial airplanes as at present designed are seldom better than one in eight. And the result is that about 60 horsepower is required to carry an airplane passenger on a three-hour journey at a speed of 100 miles per hour. Under the pressure of necessity, builders of gliders have improved the glide path up to a value of one in sixteen, as in the German "Hanover" glider. There is no reason why the same increase in efficiency should not be attained in the construction of full-sized machines with corresponding improvement in the economy of airplane transportation. Gliders must also be light, as otherwise they might have good glide paths and yet have a high rate of downward velocity in still air; and also because a heavy glider is more difficult to launch. Builders of gliders have accordingly learned to build light, while maintaining a reasonable factor of safety, and the structural lessons learned thereby may also be translated into airplane practice. The glider, moreover, is a splendid and inexpensive school for pilots, and a safe method of weeding out men who should never be pilots.

But the greatest immediate value of the glider work is in the impetus it has given to the construction of low-powered airplanes and incidentally to the small air-cooled two- or three-cylinder motor of a few horsepower that goes with them, such as the German Stax three-cylinder rotary motor which weighs only 17.5 pounds complete and yet develops 7.5 horsepower.

The Advent of the Low-Power Plane

It is really remarkable what can be achieved with the use of small power. The German Budig motorized glider, equipped with a tiny four-horsepower motor, can rise from any ground, independent of the direction of the wind, and sustain flight indefinitely. Georges Barbot, holder of the glider duration record, flying in a Dewoitine monoplane of seven horsepower, made an official maximum speed of 56 miles per hour; furthermore, his plane also made an altitude of 3000 feet and travel 600 miles on a gallon of gas. The most striking achievement of the motorized glider is the crossing of the English Channel by Barbot with a 15-horsepower motor installed in the same Dewoitine mono-

plane. Carrying only one gallon of gas, Barbot flew from St. Inglevert, France, to Lympne, England, in 61 minutes, and returned in 44 minutes, winning a prize of 25,000 francs for the trip. Flying the same plane in the United States, Barbot created a wonderful impression of maneuverability and economy, but crashed in a stormy trip from Long Island to Washington. Perhaps difficulty in meeting very gusty air is the one big problem to be solved in the construction of low-powered planes. But in spite of this inauspicious accident, there is [illegible] that the low-powered airplane is a very promising field of development, that it will be a remarkably cheap method of transportation and that the "air flivver" will soon be within the reach of every adventurous young man.

Apart from its value in technical progress, gliding is a fascinating sport. A certain amount of interest has been aroused in this latest sport in the United States, and amateurs are building and gliding all over the country.

It is also highly interesting to consider how far it is possible for amateurs to undertake glider construction and operation, and what value such work may have in furthering aviation, besides the fun of the game and the possibility of winning prizes at a meet.

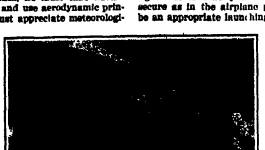
It is a well-known fact that radical discoveries and achievements have very often come from men not at all deeply versed in science or engineering. The airplane owes its birth to the Wright brothers, who were not primarily engineers, although they developed the airplane in the most scientific manner possible. It is possible that equally gifted, though now unknown amateurs may seize on the opportunities afforded by glider experimentation, and help in the scientific development of aircraft by bringing fresh and ingenious minds to bear on its problems.

Before undertaking this stimulating and useful form of activity a number of considerations have to be taken into account. A suitable terrain is essential. The National Aeronautic Association in seeking the ideal terrain, apparently found near Oakland, stated its requirements to be a long ridge rather than a hill, with a total drop of at least 1000 feet, a slope of one in four at the top of the ridge and one in eight further down, freedom from trees and obstructions, and steady wind velocities of 15 to 20 miles an hour. These requirements do not include the fact that there must be some measure of upward current. A glider will not stay up indefinitely in any horizontal wind however violent, unless there is an upward current, at least an intermittent upward current, as we have shown earlier in the article.

Typical glider flown in one of the French gliding meets. Note the trim and substantial construction

Piloting the Glider

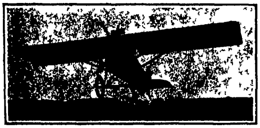
While glider piloting is reasonably safe, the amateur must not underrate its difficulties. Gliding is in some respects more difficult than piloting a powered airplane. It is more delicate, more instinctive, less susceptible to rules and systematic instruction. If the glider pilot wishes to make duration glides, he must take advantage of every favorable gust, and use aerodynamic principles subconsciously. He must appreciate meteorological conditions and adapt himself instantaneously to every variation. Patience and long experience are necessary to achieve skill. It is possible that instruments may yet be devised which will help the glider pilot in taking advantage of air conditions of every kind. But even without instruments, it can be safely said that in spite of these difficulties, piloting the glider is within the reach of any young man, physically sound, with keen perceptive faculties and a good sense of balance.



Glenn L. Martin plane designed for use in night flights by air mail pilots

Nor is building a glider such a terrifying matter. The materials required are not expensive. At a recent German meet at Wasserkuppe, one machine built of inexpensive bits of metal and wood was transported 20 miles to the meet in a push cart, yet put up an excellent and consistent performance day after day. Small boards of well-seasoned wood, a few sheets of thin-gage mild steel, readily obtainable from any large hardware house, some few special wires and turnbuckles, readily obtainable from aircraft supply houses, a few yards of airplane cloth, or some thin veneer, are substantially all the materials needed. Nor is very elaborate shop equipment needed by the amateur. The glider can be built in one's backyard with a few simple tools. Any slightly difficult wood or metal work can be readily farmed out to some small local machine or wood shop.

It is in the planning or designing of a glider that an amateur constructor must exercise the greatest care, if he wishes to build an original craft. While amateurs may ultimately develop useful and novel forms, mere "freak" machines are doomed to be a disappointment. The best gliders are those which utilize in the best possible fashion certain very simple laws of aerodynamics. "Bats" and "flying fish" and other monstrosities never succeeded in making but the shortest glides and show little or no stability.



Typical low-power airplane in flight. This is the R III sport monoplane developed in Germany

Certain basic requirements must be fulfilled. These include light construction, so that a light loading in proportion to the wing area may be secured a high aerodynamic efficiency, stability in flight, ample control under all conditions, and ample strength, combined with as light construction as is consonant with strength.

Light loading in proportion to the wing area is important because this means ease in get-away, and slow and easy landing. For high aerodynamic efficiency, a clean, graceful appearance is necessary because this means a small gliding angle, less loss of altitude when there is no favorable current, and maximum gain of altitude when there is a favorable current. Stability and correct balance in the glider are as important as in the powered airplane, and are achieved by much the same methods. A study of the disposition of the center of gravity relative to the wings and the setting of the tail relative to the wings are well worth while. Ample control surface areas are essential because the glider is so susceptible to air gusts, and at the same time the effectiveness of the controls is less than in speedy, high powered airplanes. In considering strength, it is true that a glider never has to meet the violent loads which may come on the powered airplane, but it is much lighter so that adequate strength is almost as hard to secure as in the airplane proper. Finally, there must be an appropriate launching mechanism, a form of rubber catapult, or if hauling by a rope is used the rope must be automatically released when the machine leaves the ground.

An American Cycleplane Attempt

Aerodynamic features embodied in the cycleplane that will have a material bearing on the future construction of smaller aircraft are said to have been proved with the first successful flight of an American-made machine.

The "Scientific Curiosity," so termed by its inventor, W F Gerhardt, a McCook Field employe and former officer of the Air Service, is propelled by a set of pedals similar to those used on a bicycle. By a chain arrangement, when pedalled, the propeller revolves, and in moving forward the cycleplane is lifted from the ground.

A cycleplane of much more stable construction and capable of lengthy flights in the air is promised by the inventor as the outgrowth of successful experiments with the original model.

[illegible] wings give the cycleplane its lift. It has no [illegible]. Its upward flight is governed by the elevator in much the same manner as the usual airplane. According to the inventor, the measured power required for flight is less than that which can be developed with the propeller operated with the foot pedals.

Aviation progress of late has been exceptionally rapid and quite spectacular, so much so that it has found considerable space in the daily press and in daily conversation. The thrilling flights of Lieut Russell Maughan, the inauguration of coast-to-coast aerial mail, the completion and trial flights of the giant helium-filled, American-built dirigible "Z-R1," the smashing of records for speed, endurance and altitude—these are but a few of the numerous steps forward, which will be dealt with in a comprehensive manner in an early issue.

A Delicate Balance

DR. PAUL R. HEYL, of the Bureau of Standards, has constructed a balance so delicate that it will weigh three pounds with an error of not more than one part in a billion. The method involves the weighing of large crystals in varying positions.

The balance is of the general type of chemical balance used for weighing relatively large quantities, but fitted with every latest appliance to avoid error. No human hand comes anywhere near the balance when it is in use. The crystal to be weighed is first placed in the required position in a sort of frame connected with a series of rods proceeding from the balance case and extending through a brick wall about six feet away. It is then weighed to what would be called extreme accuracy by the experimenter standing in the balance room and putting in the heavier weights by hand.

The whole balance is then encased in movable walls of cork composition about two inches thick, leaving just room enough for the control rods and for the reflection of a beam of light on a mirror, the swings of which measure the final balancing. The experimenter then leaves the room which is closed tightly with a double door and left to come to a uniform temperature. This takes nearly an hour, after which the room does not vary one-tenth of a degree from one part to another. It is most important that the two arms of the balance shall not vary in temperature by more than one-thousandth of a degree, as this would introduce into the experiment an error of one part in several million which would ruin its value. The weighing is then made by the operator sitting outside the brick wall and controlling the final delicate weights with the rods projecting through it.

Villa's Buried Treasure

AT first blush it would seem that we have no interest in Villa's bars of gold or bags of silver which he buried at night on his ranch, and indeed we have not, but some of our readers probably will have and we shall be asked to recommend the best divining rod and the shortest route to Mexico.

The story of buried money never palls and is never diminished in the telling. Indeed, legends of buried treasure are better than compound interest, for they are compounded every time they are told. From time to time expeditions are fitted out to visit the Cocos Islands or some other lair of pirate crews of the long ago. Robert Louis Stevenson knew this weakness of the human race who desire honestly to find a treasure-trove usually left by an essentially dishonest or criminal crew, and capitalized it in that rattling good story, "Treasure Island."

But all this is getting away from the divining rod. As far as all our investigations have gone, the searches by lay persons for hidden gold and silver with artificial devices have all been abortive, and we think that the Government is very much of the same opinion, for the pamphlet on divining rods, which is among their "best sellers," is eagerly sought for. We do not say that an expert geologist may not be *helped* by electrical devices. All those who have them are so very chary of ever letting one look even at the outside that our attitude is still that of a skeptic. So let Villa's buried treasure lie, for no foreigner would ever get out of the country alive with the pot of gold at the end of the rainbow, even if he found it. That fugitive from justice, Grover Cleveland Bergdoll, is believed to have buried a large sum in gold coin somewhere in Maryland. One would think that the divining rod adepts would hasten to its exact location and dig.

Saving a Cathedral by Compressed Air

Restoring Lincoln Cathedral by the Compressed Air Drill and Grouting

Westerly towers of Lincoln Cathedral. The right-hand tower, it will be seen, leans to the right

THIS is the story of the rescue from collapse of one of the greatest cathedrals of Great Britain, by means of the compressed-air drill and cement grout forced into its fissured walls under air pressure Much as we may admire the architectural beauties and wonder at the size and majestic dignity of the medieval cathedrals, it has to be admitted that in many of them the work of these early masons was of very rough and inferior character This is particularly true of the early Norman work of the twelfth and thirteenth centuries. The construction during the fourteenth, fifteenth and sixteenth centuries was generally of a better quality

The trouble with the Norman work was that the massive piers, ten feet to twelve feet in diameter, and the walls from six to eight feet in thickness, consisted of an interior of rough rubble work set in mortar, with an outer casing of dressed stone with squared and fairly well-fitted joints. In the course of the centuries the mortar, which was often of an inferior quality, deteriorated and lost its binding and holding quality, and from the thirteenth century down to the present time much of the early work has given unending trouble Naturally, the principal difficulty has been experienced with the towers, and particularly those at the crossing of the nave and transept Here the super-incumbent tower load, of from 3000 to 5000 tons weight, proved too much for the four piers upon which it rested, with the result that in many of the cathedrals, both in England and France, the piers have crushed or buckled, and the whole tower has come crashing down upon the church below This happened at Winchester, Chichester, and to the first central tower at Lincoln, not to mention several others which suffered the same fate

Several insecure towers have been saved from collapse, during the reconstruction work of the last one hundred years, only by emergency repairs in which the tower above was held up by a perfect forest of massive timber shoring, while liquid cement grout was poured into the interior rubble work to bind the mass once more, as far as possible, into a solid and unyielding support.

The present article deals with the northwest tower of Lincoln Cathedral which, in our illustration, is the one to the right showing above the main roof The lower part of the two western towers, to about the level of the ridge of the roof, is of Norman construction as will be evident from a study of the round arched windows and the plain square buttressing at the corners. The upper part of the towers was added in the later reconstruction and enlargement of the cathedral. This Norman work is characterized by the rudeness of construction referred to above. The present dangerous condition of the northwest tower, as shown in our photographs, is due partly to the nature of the construction, and also to the fact that the cathedral was badly wrecked by a violent earthquake, which took place in the year 1185, and necessitated the rebuilding of the Norman Cathedral

The cracks which were opened by the earthquake in the northwest tower, in spite of the continual repair work done at various times during the past seven centuries, have steadily widened, and the tower has settled in a northerly direction until the deviation is visible to the eye, as will be noticed from our photograph showing the westerly towers. The condition of the towers, and indeed of many other parts of the cathedral, was so serious that a vigorous campaign to secure the $250,000 needed to save the cathedral was started a few years ago, and the present work of thoroughgoing repair was undertaken in 1922.

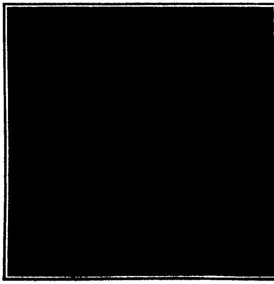
The walls of the tower are enormously massive, reaching in one place a thickness of twenty feet, nevertheless, in one wall the cracks have opened to the extent of twelve inches. It would be impossible to pull the wall back into its original position, and what is now being attempted, and very successfully accomplished, is to fill up the cracks with grout and thus hold the structure from any further distortion or settlement. This has been rendered possible by the use of a very efficient American tool, the compressed-air drill With this most useful tool holes are drilled many feet into the heart of the wall, and liquid grout is forced into the mass of masonry, where it follows along every crevice to the utmost extent of the fracture, filling all the voids and binding the rubble work into one solid and immovable mass. As compared with the old method of drilling by hand, the use of compressed-air drills and of pneumatic pressure for forcing the grout has cut down the cost of these repairs enormously Indeed, it may be said without exaggeration that the compressed-air drill has saved this magnificent cathedral, which has been visited by thousands of Americans, from destruction. A considerable part of the funds for the work has been contributed in America; and the Dean and Chapter have decided to make the repairs to the large central tower at the crossing, which is not visible in our photograph, entirely with such funds as are subscribed in the United States, and to constitute this work a memorial to American cooperation. Of the total sum of $50,000 required for this tower about one-half has been subscribed.

A Photographic Museum

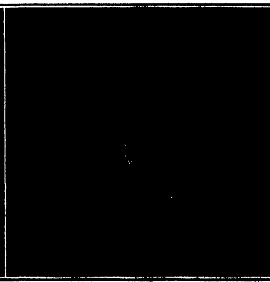
IN Prague there is a wonderful museum devoted to buttons and other fastenings for clothing. It was founded by a button manufacturer who thought that, as his fortune had been derived from these humble objects, it would be a graceful thing to found and endow a special museum of this nature. The other day we were reading a letter in a daily paper which gave an excellent idea for a museum, and we think it is worth while to pass it on to our readers. The letter suggested that Mr George Eastman found a museum of photography The idea is fundamentally sound, as it would be most appropriate for one who has done so much for photography to go a step further and collect all the historical memorials while they can be collected. Of course, Mr Eastman's profits are legitimate and are his own, but he has shown such great generosity in founding cultural schools of music and the silent drama, that it would not be impertinent, we think, to suggest to him that he is the logical person to start such an institution, the museum to pair with his great laboratory where so much work in pure science is carried on. Of course we have a few exhibits in the National Museum of Washington and in the Science Museum in London, which are useful as far as they go, but what is needed is a real museum containing all possible exhibits which will elucidate this beautiful art.

Tests of New Design of Large Hawsers

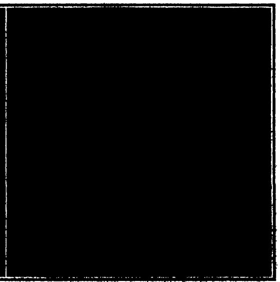
TENSILE tests have recently been made at the Bureau of Standards on 21 samples of very large hawsers. The purpose of these tests was to determine the comparative strength of a new type of construction for manila rope as compared with the standard method of construction. In the new type the inner yarns of the strands are untwisted. The strands are made up of several outer layers of twisted yarns binding this inner compact mass of fibers, these strands being twisted in the usual manner to form the rope. The tests showed that in all cases the new type of construction increases the strength of the rope.



This wide crack is typical of the disruption that was taking place in the old Norman Tower



Even this tower window, 180 feet above ground, was falling apart. Note the temporary props



Cement grout forced at high pressure into holes drilled in the masonry solidifies the whole mass

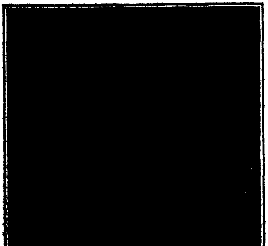
Automobiles and Near-Automobiles

One of the subjects that is perennially green is that of the small automotive vehicle which may be classified as an actual car or as a motorcycle, according to the individual predilection of the classifier or the state of his digestion. There seems to be no end to the number of ways in which the automobile and the power bike may thus be hybridized One of the latest and we think one of the neatest specimens is illustrated at the upper right corner of the page. Our correspondent caught it on the fly in London's shopping center, where it was the cynosure of all eyes. It is more cycle than car its major claim to the latter classification consisting in the presence of a seat rather than a saddle A seat for the driver, that is to say, the passenger, if one is carried, apparently must trust to the fortunes of war One might ride for a long distance on that smooth platform behind the driver, but if the plaints about the condition of the London streets are based upon facts one would not probably stick for very long.

The springing of this vehicle is rather more in the direction of the car than in that of the cycle, too There is a long, semi or quarter-elliptic affair of four leaves running forward from a point on the frame beside the rear wheel, to an anchorage beneath the driver Starting is in traditional motor-bike style the kick pedal being plainly visible in our view and steering follows the vogue of the handle-bar rather than that of the wheel The attainable speed is given as 40 miles per hour, and the gasoline consumption is highly favorable In this country, in fact, this feature alone would stamp the machine as a cycle rather than a car but the Briton is quite accustomed to his light car that does anywhere up to 50 miles per gallon, and that is beyond question an automobile Indeed, so largely has he developed this sort of conveyance that the good old Tin Lizzie no longer qualifies for sporting events that are closed to "light cars" Both in weight and in piston displacement, the flivver escapes this category in the England of today, so that the Briton is far less loath than us to recognise as an automobile a hybrid of the sort illustrated on this page

The one at the lower left is another London type This vehicle makes the definite claim to classification as a car, the owner and designer referring to it as a runabout It carries a 2½ horsepower engine, and its constructor proudly asserts that it is faster than any motor cycle of similar power It will be noted that he has bolstered his claim to the proprietorship of a real car by installing running boards and a hand brake and that again the driver rides in the comparative luxury of a regular seat Indeed he has less the effect of riding astride than his compatriot diagonally opposite him on the page and is sufficiently near the road to get all the thrills of racing out of a very moderate speed.

The photograph in the center of the page is of French origin, and shows a vehicle which is plainly enough a regular automobile It represents an effort to shorten the wheel base for tight driving in the congested city The tiny four-cylinder motor is installed at the rear of the car instead of the front An effort is made to balance weight by placing the engine proper at one side and the flywheel at the other and the position of the latter indicates that full advantage has been taken of the motor's unique location to avoid the necessity of transmitting the power around a corner to the rear axle The horsepower is given as eight The car was exhibited at the recent French automobile show, where it elicited much favorable comment



Built close to the ground describes this example of the London cycle-car

Forests and Fertility

It is one of the unfortunate results of civilization that while it enables men to live in much larger numbers on the ground they can only do so by annihilating other forms of life In this way man has ruthlessly destroyed trees to make his house and to make way for his flocks, without considering what effect their destruction may have on the climate and resources of the region he lives in This point never was considered until the increasing ill effects forced themselves on man's notice by curtailing his means of livelihood. It cannot be altogether accidental that where mountains and uplands have been denuded of the forests which naturally clothed them the results have always been destructive floods in the rainy season and shrivelled up rivers in the dry

Most people have noticed that on the hottest day a growing leaf is always cold the reason being that the plant has discovered exactly what amount of moisture it is necessary to evaporate from its pores to keep its temperature down Humanity does exactly the same thing when it is properly acclimatized In the hottest climates, the natives' skins are normally as cold as a snake's whilst the visitor is streaming with useless perspiration too profuse to evaporate The plant has to absorb water through its roots from the ground so that if it cannot penetrate deep enough to get sufficient moisture, it dies. The leaves of a tree are always cool and evaporating moisture and it follows that every breeze that blows over them is cooled and moistened which means that the dew point has been lowered If the wind now encounters a hill-slope on blowing up it, the dew point, is still further lowered by the chill caused, and rain is all the more likely to result The ground also under the tree is shaded from the sun and is therefore cooler and more moist than if it were exposed In addition when rain falls it is easily conducted down the holes made by the roots into the soil, and there is not so much left on the surface to run off or be lost in evaporation

In the other case, where there are no trees the soil gets very hot and dry, and the herbage having roots that do not penetrate so deeply gets parched Since the ground surface is caked any rain runs off freely, and as the earth has been baked hot by the sun, there is much loss in evaporation More than this, since the quantity of water running off is so much larger its scoring and carrying powers are much greater The result is that a great quantity of stones earth, humus and detritus is always swept off slopes that have been deforested, filling up and choking the river beds wherever the slopes are too flat to enable the current to carry it farther A good example of this is the port of Pisa.

In the fourteenth and fifteenth centuries the Apennines became deforested some say because it was believed that the devastating plagues of the Middle Ages were caused by trees, or it may have been to get more pasture for the growth of the wool which made Florence so rich and famous At any rate the result was disastrous The Apennine pastures dried up the rivers rapidly rose in flood and carried more and more gravel down to the sea The harbor of Pisa became choked and obliterated the Pisans ignorantly blaming the Genoese for having done it in one of their raids Now there are miles of unhealthy marshes between Pisa and the sea and there is no harbor for even a row boat to shelter in and this is all traceable to the ground getting hard and caked in the absence of trees—*Abstract from articles by Col H de H in Discovery (British) for May 1923*

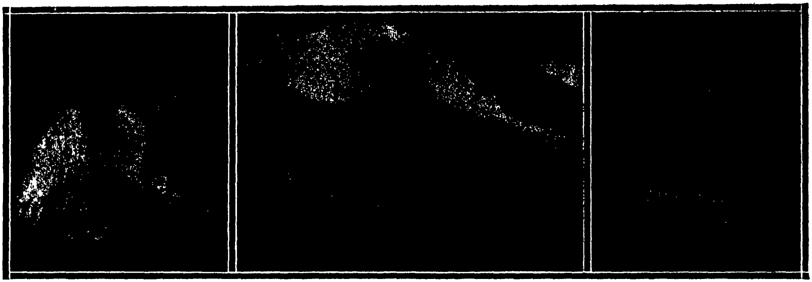
A light French car with engine at the rear, and shafts parallel to the axles

One of Britain's latest efforts to combine in a single design the advantages of car and cycle

A New Anesthetic from Sleeping Flowers

As far back as 1908 florists complained that carnations when placed in green houses would go to sleep and those which had not opened would fail to do so causing great loss in their business. Investigation proved leaky gas fixtures to be the cause Gas contains four per cent of ethylene and it was shown that one part of this gas in 2,000,000 parts of air caused already open flowers to close Other investigations showed a similar effect of the gas on other plants This led Dr Luckhardt and Mr Carter of the University of Chicago recently to test the gas as an anesthetic The gas was tried first on numerous animals such as frogs mice guinea pigs rabbits and kittens that were all found to be put to sleep by it without any apparent after-effects of a disagreeable sort The anesthetic was finally tried on a dog who went out completely in less than five minutes on a mixture of 90 per cent ethylene and 10 per cent oxygen The experimenters then tried it on themselves They describe the effect of the gas mixed with oxygen as exhilarating and giving a sense of well being They became unconscious and then subsequently recovered without realization that they had been unconscious Several students then volunteered. Complete surgical anesthesia with muscular relaxation was produced in a few minutes Subjects had pins thrust through their arms were pinched severely enough to leave black and blue areas and one was beaten on the soles of his feet with a Stillson wrench without any sensation whatever or memory of discomfort Recovery was complete in a few minutes The only after-effect was slight weakness and slight nausea. In every case the subject ate a full meal within a few hours after recovery It is claimed that the new anesthetic gives loss of sensation long before complete surgical anesthesia is established that it may be maintained with complete muscular relaxation, yet without any sign of asphyxia shortness of breath or effect upon the blood pressure and that there is rapid recovery even after long administration without evidence of after effects

Important as this discovery is to all of us there is nothing definite as yet to indicate its importance to the medical world. However one thing is obvious and that is the relatively insignificant cost of this new anesthetic Furthermore it is almost universally available although its use must be kept in competent hands to avoid any possible danger from over-dosage



Left Dropped through a glass tube upon a hardened steel plate the ball's rebound is a measure of its hardness and resiliency *Center* Taper-gaging the steel sphere to determine its exact diameter *Right* Examining the balls with a 20-power microscope, in the search for surface imperfections

Tests and checks to which high-grade ball bearings are subjected before they leave the factory

Ball Bearings and How They Are Made

The Tiny but Perfect Spheres that Keep Down the Friction Toll in Modern Machinery

By Robert G Skerrett

THERE was a time, and that not long ago, when a lubricating film of some sort was the only means of offsetting the clinging or hampering contact between contiguous sliding or revolving surfaces, and, even so, there still remained the demand for more or less unproductive power to overcome the inertia of the "dead load" and to keep the mass in motion. Thanks to the development of ball and of roller bearings the effect of these physical conditions has been very greatly altered for the better, a lesser effort can achieve more than was feasible before the adoption of these beautifully and accurately fashioned bodies of steel.

There are no statistics available to tell the whole story of America's annual production and use of these anti frictional parts, but the output is numerically immense, and the fields of application both wide and manifold They have a place in the get up of every automobile, motor truck and tractor, they are employed by the million in electric motors, sewing machines, talking machines, typewriters, gyroscopic compasses, and an endless variety of other mechanisms, and thousands of machine tools perform their work at a lower cost by reason of their ball or roller bearings. Indeed, the list would be well-nigh endless if every service of these helpful mediums were recited and the engineer is striving continually to find other ways to utilize them Passing over the roller bearing for the time, we shall tell here the story of the manufacture of its older brother, the ball bearing.

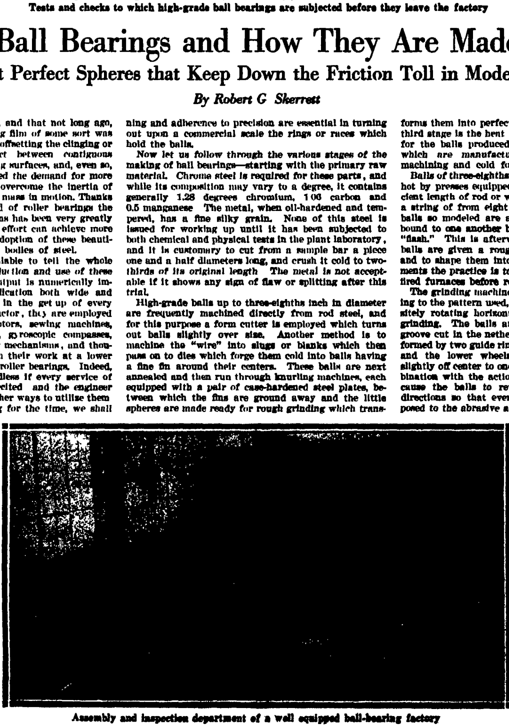
The use of these bearings has become so general and they can be purchased so readily that the average person looks upon them as a comparative commonplace and gives little thought to how they are made To him a sixteenth of an inch is a relatively diminutive measurement, and yet the steel balls for bearings are fashioned to a dimensional precision of a ten-thousandth of an inch This is essential, for if the assembled spheres in any bearing were not of well-nigh perfect uniformity in size the load upon them would not be evenly distributed, and the bigger member of the group would have laid upon it the whole burden and would probably be shattered in consequence. And the same technical cunning and adherence to precision are essential in turning out upon a commercial scale the rings or races which hold the balls.

Now let us follow through the various stages of the making of ball bearings—starting with the primary raw material. Chrome steel is required for these parts, and while its composition may vary to a degree, it contains generally 1.28 degrees chromium, 1 06 carbon and 0.5 manganese The metal, when oil-hardened and tempered, has a fine silky grain. None of this steel is issued for working up until it has been subjected to both chemical and physical tests in the plant laboratory, and it is customary to cut from a sample bar a piece one and a half diameters long, and crush it cold to two-thirds of its original length The metal is not acceptable if it shows any sign of flaw or splitting after this trial.

High-grade balls up to three-eighths inch in diameter are frequently machined directly from rod steel, and for this purpose a form cutter is employed which turns out balls slightly over size. Another method is to machine the "wire" into slugs or blanks which then pass on to dies which forge them cold into balls having a fine fin around their centers. These balls are next annealed and then run through knurling machines, each equipped with a pair of case-hardened steel plates, between which the fins are ground away and the little spheres are made ready for rough grinding which transforms them into perfect spheres, slightly over size The third stage is the hent treatment, and this is alike both for the balls produced by the form cutter and those which are manufactured by the dual process of machining and cold forging

Balls of three-eighths inch and over are usually forged hot by presses equipped with suitable dies, and a sufficient length of rod or wire is used in each case to make a string of from eight to ten spheres at a time The balls so modeled are approximately spherical and are bound to one another by a thin strip of metal called a "flash." This is afterward sheared and the separated balls are given a rough grinding to remove the flash and to shape them into roundness. In some establishments the practice is to anneal the forged balls in gas-fired furnaces before rough grinding.

The grinding machines, which vary somewhat according to the pattern used, consist in the main of two oppositely rotating horizontal wheels, one which does the grinding. The balls are held in an annular V-shaped groove cut in the nether wheel or by a similar runway formed by two guide rings, interposed between the upper and the lower wheels. These wheels are mounted slightly off center to one another, and the result, in combination with the action of the V-shaped groove, is to cause the balls to revolve continuously in changing directions so that every part of their surfaces is exposed to the abrasive action of the carborundum wheel.



Assembly and inspection department of a well equipped ball-bearing factory

The grinding operation is done dry—the dust being carried off by a suction attachment, and the average machine will treat about a hundred one-half inch balls, for instance, every twenty minutes.

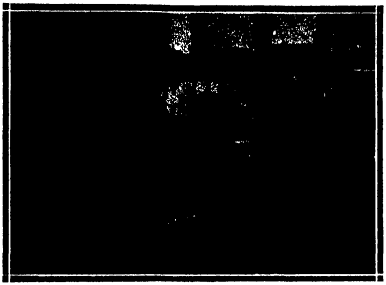
No small part of the acceptability of the ultimately finished ball depends upon the manner in which it is first hardened and then annealed to relieve it of internal stresses. For this purpose the balls are fed into gas-fired furnaces—often designed to rotate, and at uniform intervals groups of the balls flow in for treatment through pipes which shield them the while from the oxidizing action of the atmosphere. After being subjected for a suitable period to a temperature of approximately 1470 degrees Fahrenheit, the balls are automatically discharged

from the furnaces and dropped into a bath of oil or water—the choice of fluid depending upon the size of the balls. The depth of the tank is regulated so that the balls will be cold by the time they reach the bottom, whence they are moved by a mechanical conveyor The furnaces are controlled by electric pyrometers, which make it possible to hold the temperatures at points which experience has proved best suited to each size of ball and to the particular class of steel used for them

After hardening, the balls are tempered by being boiled, according to their size, in oil or water for several hours. While this temperature is relatively low it induces physical changes in the steel, "seasons" it, and, without affecting the surface hardness, brings about internal readjustments of the metal and puts it in a state to withstand a considerably greater crushing stress. When the balls have been annealed, they are then freed of any attached scale in tumbling barrels within which they are agitated in the presence of a mixture of potash and grit, and this is succeeded by a second barreling operation which, by recourse to potash and a fine abrasive, finishes the surfaces of the balls to a point where they are ready to undergo the hardness test. The manner of making this varies. At some factories ten balls from every batch are crushed successively to destruction in a hydraulic press, and the pressure required to do this in each case is indicated by a gage Having passed this test, the balls are now given their final finish and polish

The finish grinding may be done either by machines substantially like the rough grinding machines, save that finer grinding wheels are used and the work is done in oil, or apparatus may be employed of the knurling type, already referred to The grinding wheel is forced against the balls at a pressure of from 400 to 600 pounds. The final polish is imparted by two or three "lapping" operations. For this purpose "stones" of fine grade are substituted for the harder cutting wheels and then a leather wheel, with a mixture of crocus and oil, completes this phase of the process. At some plants the balls leave the first lapping machine from three to ten thousandths of an inch over size. From the second machine they issue one ten thousandth of an inch over size, and from the last machine they come substantially exact as to size and of a high finish. Glittering as they are, however, there is yet more to be done to them before they acquire the perfect polish demanded in the commercial article

Following the lapping, the balls are tumbled in a barrel containing rouge and a quantity of bits of leather, and when this has continued for many hours the balls are given their final shine in another tumbling barrel, charged with a solution of potash, in which they remain for a period of from eight to sixteen hours. Care has to be taken that this treatment does not go on long enough to spoil the color of the balls by imparting to them a brownish tinge. The last step involves rolling the balls about in a third barrel carrying a mixture of leather and sawdust, and this dries and leaves them silvery spheres of wonderful smoothness.



Heat-treating furnaces and quenching tanks in which ball bearings are hardened

While the lapping and tumbling operations are in progress, the balls are from time to time very carefully gaged. The concluding gaging, however, does not take place until about 12 hours after the balls are removed from the drying barrel This allows ample time for them to cool down In the meantime they are visually inspected for cracks, flaws, or soft spots. Girls are employed for this work, and they show remarkable skill in detecting quickly defects which would scarcely be caught by the untrained eye even when pointed out

The inspection is done in a well-lighted department and each girl, seated at a table, has a shallow tray in which is laid a bottom of glass or a sheet of white paper, the reflected light in either case serving to illumine the underside of the ball so that no imperfection can hide in the shadows. Ten or a dozen balls are thus examined simultaneously By tipping the tray slightly the balls are induced to roll away from the keen-eyed operative, and the least lack of sphericity in a ball will cause it to deviate laterally from the straight path Defective balls are picked up by magnets or pincers and cast aside, while the remaining ones are dropped into a box for gaging In some plants the inspectors wear soft chamois gloves, for the least touch of the bare fingers may produce a rust spot In the course of an eight-hour day a girl expert can examine quite 5,000 half-inch balls, for example

From the inspection department the balls are sent to a gaging room, where the atmosphere is maintained uniformly at a prescribed temperature, and there the balls are run through machines which automatically classify them into sizes varying by steps of five ten thousandths of an inch The process consists fundamentally in letting the balls roll down between a pair of slightly spreading metal guides and as they travel along the tapering slot so formed the balls drop successively through openings, corresponding to their diameters, into bins or boxes beneath Over-sized balls are deposited in the lowest and last receptacle. The final dimensional test is made by girls who do the gaging by pushing the balls through rings or perforated plates, which are accurate within the limits of possible measurement The operatives judge by the sense of touch, i. e., the ease or reluctance with which the balls can be put through the prescribed ring or plate, whether the spheres are acceptable or not.

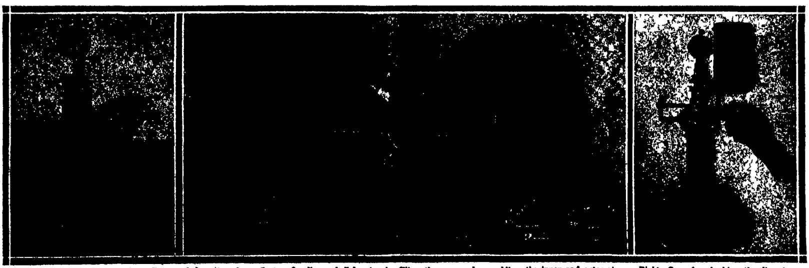
While the guaranteed accuracy of the balls is within the margin just cited, there are factories which produce these steel spheres considerably closer to the stipulated diametric dimension For instance, the balls are graded into eight sizes intermediate between the limiting sizes, and the difference, therefore, between two such successive groups is only one fifty thousandth of an inch All the balls for any one bearing are taken from but one of these groups, and in this way the spheres in a given bearing are as nearly identical as it is humanly and mechanically feasible to make them

No less care is exercised in the manufacture of the races and cages which hold the steel balls of a ball bearing The inner and outer rings for the larger bearings are machined directly from oil hardened drawn-steel tubing, while the rings for the smaller sizes are cut from solid bars of case-hardened steel—the inner ring being made from the core removed in machining the outer ring. Whether tubing or bars be employed, the material is chrome steel

When the rings have been cut and machined to within eight or twelve thousandths of an inch of their ultimate diameters the bore is beveled at each end, and a groove is turned in the ring for the ball-track With this work done notches are cut between a side and the ball race so that the balls can later on be inserted Practice in this respect varies in different plants. The rings are now ready to be heated in gas-fired furnaces and then hardened by dropping them into an oil bath They are next tempered by boiling for a considerable while in water The tempered rings are tested for hardness and physical integrity by being dropped edgewise on to a steel anvil This is called the bounce test, the height of drop and the corresponding height of rebound being different for each size of ring The examiner determines by the bell like sound of the dropping ring whether it is perfect or faulty both structurally and as regards hardness

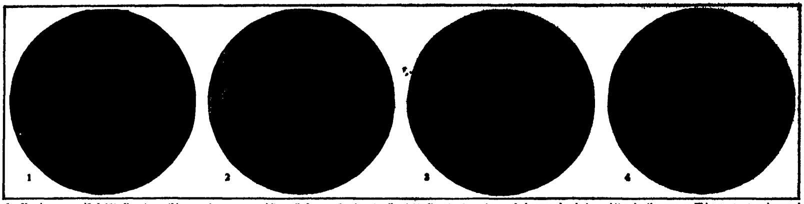
Having passed this test, the rings are ready to be ground to their final sizes, and this is done with remarkable accuracy Now comes the still more important step of grinding the ball-track or race, the path of which is of a radius only about 3 per cent greater than that of the balls which run in it In order that the artisan can do his part to a nicety, his grinding machine is frequently equipped with a gage which visibly indicates just how the process is progressing. When a ring is thus finished it is subjected to a final inspection which is quite thorough Here, again, expert training plays its part, and the qualified inspector, merely by employing a scraper, fashioned out of a

(Continued on page 375)



Left: Apparatus for testing the ball race of the outer ring. *Center:* Loading a ball bearing by filling the cage and assembling the inner and outer rings. *Right:* Gage for checking the diameters of the balls

Putting the balls and the races together into the finished bearing



1 Uroglena, magnified 150 diameters this organism causes cod liver-oil flavor 2 Asterionella (150 diameters); note regularly spaced coloring matter in the arms This causes geranium and fishy odors. 3 Appearance of asterionella after copper sulfate treatment note destruction of coloring matter and faint, shell-like appearance. 4 Synura (150 diameters); note faint outlines of cells outside the (yellow) coloring matter This organism is responsible for the familiar cucumber flavor in water

Three types of micro-organisms whose presence in water gives rise to bad odor and flavor

Keeping Our Water Fit to Drink

Microscopic Denizens of Our Reservoirs, and the Means Used to Keep Them Under Control

By Dr Frank E Hale

Chief Chemist Bureau of Water Supply New York City

THE water supply of New York City is impounded in approximately fifty reservoirs Many of these are of extremely large capacity Ashokan reservoir alone contains 130 billion gallons Kensico 30 billion gallons Croton Lake 34 billion gallons and nine other reservoirs on the Croton watershed range from 3 to 16 billion gallons each The entire Croton watershed with its twelve reservoirs and six lakes has a combined storage of 103 billion gallons Only one large reservoir Hempstead Storage exists upon the Long Island watershed Several distribution reservoirs within the city limits are of nearly a billion gallons capacity The mere handling of such immense quantities of water presents a serious problem

The Department of Water Supply has three laboratories and microscopic examinations are made at all three Every one of the above reservoirs requires examination on a regular schedule not only at one point, but usually at several Reservoirs with top and bottom draft are sampled at top and bottom and the largest and the most important are sampled at several points. Last year 4 177 microscopic examinations were made

From the standpoint of palatability and of the esthetic character of water supply there is no more important examination than the microscopical analysis This examination discloses and measures the minute animal and plant life that is present in all surface waters and in some well waters Large amounts cause an unsightly turbidity and even relatively small quantities frequently cause complaint because of a scum produced when bath tubs are filled with hot water or of a stain left upon the sides of the white porcelain The water of swimming pools if unfiltered may be unsightly Industrial enterprises may be affected for example, the staining of clothes in laundries and interference with the manufacture of correct colors by dye manufacturers and with the dyeing of goods by the dyers Photography may also be influenced The presence of certain types of microscopic organisms frequently serves to identify the source of a water The contamination of a well supply by surface water may be indicated by the presence of microscopic organisms

By far the most important reason for determining microscopic organisms is their connection with disagreeable tastes and odors in water supply Those so-called littoral growths which are attached to the banks or bottoms of reservoirs and which attract the quickest attention are not concerned as a rule The trouble is caused by minute floating forms which manufacture essential oils or perfumes like those of flowers Exceedingly minute amounts produce pleasant aromatic geranium or grassy odors which become fishy oily pungent or vile in larger amounts or upon decay of the plant growths Particular species may frequently be identified by the odor by those who are trained in this work

Three groups of odors are distinguished aromatic (geranium) caused by diatomaceae grassy caused by cyanophyceae and fishy caused by chlorophyceae diatomaceae and protozoa There are in all 22 species which have been known to cause trouble

In New York City's supply despite the diversity of its sources the only species which have given offense from odors or taste have been *Asterionella* Tabellaria Anabaena Aphanizomenon (with admixtures of Clathrocystis Microcystis and Coelosphaerium), Uroglena Synura Dinobryon and Peridinium

Asterionella when present in 500 to 1 000 standard units per cubic centimeter produces a slightly aromatic odor At 1 000 units rarely less the odor is distinctly similar to that of the geranium The odor increases in intensity with increasing numbers until several thousand produce a fishy odor The fishy odor is also produced when smaller quantities die

Tabellaria and similarly Asterionella in very small amounts produces an earthy odor (also produced by large amounts of Synedra) passing through the aromatic geranium and fishy stages with about the same relative quantities of organisms as Asterionella At times the odor of Tabellaria has suggested illuminating gas no other organisms being present

Anabaena and Aphanizomenon, when present in 500 to 1 000 units produce a faintly grassy odor like freshly-cut grass With larger numbers the odor becomes pungent like nasturtium *In large numbers or when decaying*, the odor is of vile pigpen character

Uroglena produces an oily, fishy taste and odor first noticeable in probably 500 to 1,000 units In larger quantities it is very disagreeable the flavor being that of cod liver oil

Synura may cause trouble apparently in any amount, judging from the recent experience, at least as little as 50 units The taste is variously described as cucumber, muskmelon fishy etc It leaves a bitter after-taste. The after-taste is noted when the undestroyed organisms are in the drinking supply and in such case there is but very slight first taste Water containing the dead organisms has an immediate first taste and practically no after taste

Microscopic organisms apparently do not affect the health Possibly the taste and odor at times produce nausea or distaste for food It would take 12,000 units of Asterionella per cubic centimeter to add a milligram of solid matter to a glass of water hence the practical impossibility of any chemical effect upon the body

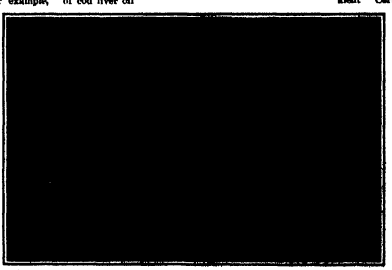
The first method of control is to shut off the troublesome reservoir and allow it to stand if possible In three weeks to three months the trouble will usually disappear This method cannot be employed with certain of the distribution reservoirs, as they are not equipped with a bypass The second method is to shift draft from one portion of a reservoir to another if possible, as for instance, from the east basin to the west basin at Ashokan reservoir The third method is to shift draft from one depth to another Since 1912, draft at 75 feet depth at Croton Lake has reduced the organisms reaching the city by 75 per cent. Certain forms, particularly the Cyanophyceae, tend to float in the upper water Probably due to temperature and light, the diatoms and protozoa may at times predominate in the upper water

Both the Ashokan and the Kensico aerators have been employed to help remove the taste and odor-producing oils from microscopic organisms. The odor to leeward of the spray is obvious when growths are prevalent Certain delicate organisms are partially disintegrated, Uroglena, Synura Dinobryon, Anabaena and Asterionella. It is not the air but the splashing and jolting that produces the effect.

In the recent trouble with Synura in New York City's supply and previous experience with Tabellaria, it has been learned that chlorine partially kills certain microscopic organisms and sets free the tasteful oils also, by large-scale tests on the watershed, that increased dosage with chlorine will destroy the taste and odor in amounts of chlorine not too high for the excess to disappear within a reasonable time, thus not producing taste of chlorine in the water of the service taps.

The method of widest application in the destruction of microscopic organisms is that of Moore and Kellerman, the application of copper sulfate in dosage ranging from 0.05 to 1.00 parts per million by weight according to the particular species. The effect of poisoning of microscopic organisms by copper sulfate is shown by an immediate intensification of distinctive odors, by reduction of the plankton

(Continued on page 375)



Chlorination plant at the Kensico reservoir of the New York water-supply system

A Midget Wind Tunnel That Works Like a Giant

BY the utilization and adaptation of compressed air for the testing of airplane models in a special wind tunnel erected expressly for that purpose, the National Advisory Committee for Aeronautics—one of the outstanding organizations of its character in existence—is performing some very remarkable work at its Langley Field, Virginia, laboratories where a midget experimental chamber of unusually small dimensions is now in active use.

The theory of the usefulness of this particular type of tunnel the first of its kind harnessed for research investigations in this country is based upon the fact that at constant temperature, the density of the air increases in proportion to the absolute pressure This simply means that a model of a wind tunnel one-twentieth full size where the pressure is maintained at 20 atmospheres provides conditions the same as those that occur where an airplane flies under natural conditions at the same speed as that used in the model tests. This system of testing eliminates all scale corrections and is productive of accurate results as reliable as though a full sized model were being used The novel tunnel was originated and designed by Dr Max M Munk while the mechanical equipments were designed by D L Bacon

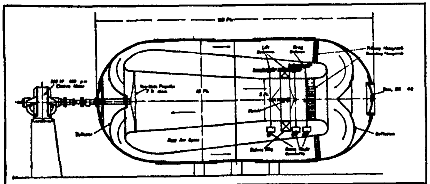
Compressed-air wind-tunnel at Langley Field, showing observation platform and air compressor

The tunnel proper is five feet in diameter at the experimental chamber and is enclosed in a cylindrical tank with hemispherical ends. The walls are hollow, providing an annular dead air space in which the balance mechanism is installed. The steel tank is strong enough to withstand an internal pressure of 20 atmospheres while it is large enough to provide a return path for the air stream between the walls of the tunnel and the tank A balance of novel construction is arranged for electrical control either by hand-operated switch or automatically from outside the tank. These manipulations of the switch attach or release heavy balancing weights by means of special cams or else they move lighter weights along the balance arms. The airplane model is attached to the balance by means of wires there being three balance arms for measuring the lift drag and pitching moments of the machine Observations are taken through glass holes in the shell of the tank. The tank is inflated by two electrically driven air compressors

The steel tank mounted on a concrete foundation and partially surrounded by a working platform is 35 feet long, 15 feet in diameter and weighs 83 tons. An observer who is stationed on the platform makes settings and readings by looking into the tank through the small peep holes. The cast steel door that provides access to the curious tank chamber is at one end while the drive shaft for turning the propeller passes through the shell at the opposite end. The tunnel proper is made of wood, cylindrical at the experimental chamber with conical approach and exit sections supported within the tank by a structural steel frame Trumpet shaped deflectors made of sheet metal are fitted into the tank at either end to assist in maintaining a smooth flow of air from the inner to the outer channel and vice versa.

Circulation of the air is effected by a two-blade propeller seven feet in diameter located in the outer end of the exit cone and driven at a speed of 900 revolutions a minute. A 250-horsepower motor mounted on a separate base at the end of the tank drives the propeller through a flexible coupling. This drive shaft is made tight against air leakage where it passes through the head of the tank by a loosely packed gland through which oil is circulated. This oil flows by gravity from a special oil reservoir maintained at tank pressure and is returned after use to the reservoir by a special motor-driven pump.

When operating at its greatest density the new Langley Field air tunnel is equivalent in scale to a tunnel 100 feet in diameter running at 60 miles an hour The tank can be inflated to 20 atmospheres in one and one half hours by means of the two compressors A primary compressor driven by a 200 horsepower motor is used to provide pressure conditions that range from one to eight atmospheres If greater pressure is desired a secondary or booster compressor is also yoked for service, it being driven by a 150 horsepower induction motor The information obtained from the wind tunnel tests that are made at Langley Field can be directly applied by the designers at the drawing boards who are working on new types of airplane models



Vertical longitudinal section of Langley Field's midget wind-tunnel

It is interesting to contrast this diminutive air tunnel with the huge French wind tunnel described in our August, 1928 issue The French air tunnel has a wind tunnel 10 feet in diameter and a fan which gives a maximum air current of 240 feet per second The electrically-driven air fan alone is about 20 feet in diameter

Line Radio Communication

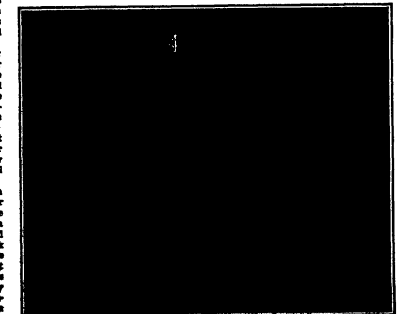
A PUBLICATION giving an introduction to the subject of line radio communication has recently been prepared under the direction of the Chief Signal Officer of the Army with the cooperation of the Bureau of Standards This pamphlet gives an explanation of how messages are carried to distant points by radio frequency currents directed over ordinary telephone lines or power wires The fundamental principles of radio and its relation to line radio telegraphy and telephony are discussed This pamphlet Signal Corps Radio Communication Pamphlet No 41 entitled Introduction in Line Radio Communication can be obtained from the Superintendent of Documents Government Printing Office Washington, D C at 10 cents per copy

A 29-Ton Portable Riveter

IN connection with the Niagara Falls power development the problem arose of constructing the spiral shell for the 70,000-horsepower turbine together with the penstock The size of this assembly is extraordinary, and since it must hold water without leakage under a pulsating pressure of about 110 pounds per square inch the riveting of the plates must be of boiler quality Owing to the size and weight of the volute and penstock a portable riveter is required while the large rivets and plates call for one of high tonnage and long reach

These demands have been met by the design and construction of the huge machine illustrated on our cover this month The total portable weight of this riveter is 57,750 pounds as against 25,000 pounds for its largest portable predecessor The frame is a single steel casting weighing 33,000 pounds the additional weight resides in the spindle and the riveting mechanism

The supporting mechanism is so designed that when revolving the frame on the spindle or tilting it upward or downward from the horizontal the center of gravity of the entire assembly hanging upon the crane hook is neither raised nor lowered The suspension beam (at top) the two vertical links the spindle housing and the spindle form a parallelogram with overhung support at the crane hook directly above the center of gravity of the entire machine Thus the friction of the bearings and the inertia alone have to be overcome in shifting the riveting jaws from one point on the work to another and two motors of two horsepower each are actually sufficient for the job The tilting motion is limited to 30 degrees below the horizontal but the rotation can be carried through the complete circle



The world's largest portable riveter, whose design was necessitated by the turbine job for the Niagara power development

Wired Wireless Broadcasting

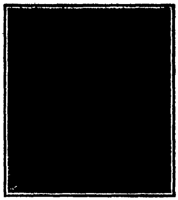
THERE was recently given the first demonstration of commercial wired wireless broadcasting as applied to electric light wires on Staten Island New York City The studio is not unlike the usual radio studio The output instead of going to an aerial and ground connection is delivered to the electric wires passing by the studio

The wired wireless broadcasting company is planning an 18-hour daily program Electric light users can subscribe for the service in which case they are furnished with a compact receiving set which is attached to any electric light socket or outlet by means of the conventional plug The lowest subscription rate provides for a crystal set and head phones while the highest rate provides for a loud speaker set If the Staten Island installation works out successfully both technically and commercially the idea will eventually be extended to other electric light systems.

Shifting Speeds With An Oil Pump

Some Details of a New British Variable-Speed Gear Without Gear-Wheels

By P. J. Risdon



The valve plate between the pump and motor units

ALTHOUGH this system of what may be termed "gearless gearing" has been in use for some years for such purposes as elevating naval guns and for the steering gear of ships, its application for other purposes has been restricted At present, however experiments are being conducted in England with a view to its application to automobiles. If these experiments are successful the outcome will be a revolution in the design of road vehicles. The subject is therefore of such great and direct interest to all car owners that we shall endeavor to treat it in as untechnical a manner as possible for the benefit of those who are not engineers.

Supposing we have a vertical pin or hub on which a ball-bearing bicycle-wheel is mounted If the wheel is horizontal there is no tendency for it to rotate, but if we tilt the assembly to a sufficient angle the mere weight of the tire valve will be sufficient to move the wheel round until at last it will stop with the valve at the bottom of the slope Now suppose that there is no valve and that the wheel is perfectly balanced if we then place a weight near the top of the slope, or impart a purely vertical pressure, the wheel will move round More generally, if a pressure be imparted at right angles to the plane of a balanced wheel or disk in any position, no movement takes place, but if we impart the pressure *at an angle to its plane* and if friction be eliminated or reduced sufficiently, we cause it to rotate

The gear that utilises this principle comprises essentially two units. One of these consists of a special design of multi-cylinder pump for pumping oil The other consists of one or more motors driven by oil delivered under pressure by the pump. The pump and motor may be placed at any convenient distance (within reasonable limits) from each other and at any angle or different height, and the two connected by a pair of pipes for the flow and return of oil Alternatively the motor casing may be bolted direct to that of the pump casing so as to constitute a double unit, with the driving and the driven shaft in allnement The only difference is that in cases where the two units are separated, there is a valve plate on one end of each, to which the ends of the two oil pipes are coupled We describe the direct-connected type

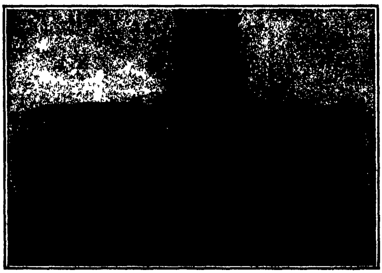
The gear with the outer casing removed, showing pump and motor complete

The pump is housed in an oil tight case and comprises a thick solid cylinder called the "barrel" in which nine holes are bored concentrically so that it looks something like a large revolver barrel The holes are not bored right through the barrel but from the dead end of each a smaller hole is bored connecting the bigger holes with oval-shaped ports in the other end of the barrel The barrel itself is keyed on the driving shaft and rotates with it A set of pistons works in the cylindrical barrel holes and these pistons are coupled to what is known as a "socket ring" by connecting rods with cup and ball connections so as to allow of a certain amount of play, the necessity for which will be seen later The pistons are hollow, and as the system is charged with oil constantly circulating under high pressure, the spherical bearings are always well lubricated. The socket ring is secured on the driving shaft by means of a universal joint, so that as the shaft rotates the socket ring rotates with it. The socket ring bears upon a set of circumferential rollers within a cup-shaped housing, the end thrust being taken by a separate set of conical thrust rollers. The housing is mounted inside the pump casing on a pair of trunnions, a vertical shaft and worm enabling the housing (and with it the socket ring) to be tilted to an angle of about one in two and one-half on either side of a plane normal to the shaft

Between the pump and motor barrels is a gunmetal valve plate with a pair of curved ports right through it The center of this valve plate is bored and bushed to receive two sets of roller bearings on the ends of the pump and motor shafts. A hole drilled through the valve plate enables oil to pass from the outer pump casing to the outer motor casing and vice versa, thus maintaining an equal supply of oil in each

When charging the system, oil is admitted to the casings from a reservoir and the pump is run for a short time Any imprisoned air is then released by means of air plugs which are replaced. The reservoir is then replenished, the pump is run again and any remaining air is released by air valves on the valve plate The gear is then ready for work

Let us now suppose the parts to be assembled within the casing, that the system is full of oil, that the pump shaft is coupled to a suitable prime mover such as an electric motor or an engine, and the oil motor shaft to another shaft that has to be driven It is important to remember that the pump and motor shafts are in no way connected, but are free to rotate at different speeds. If the pump socket ring be first adjusted by the worm so that it lies in a plane at right angles to the axis of the shaft, and the engine be then started and run at full speed, the socket ring and pump will merely rotate without any pumping actions taking place and consequently without affecting the motor at all, so that the motor shaft will remain stationary But if we gradually tilt the pump socket ring in either direction it will be forced to rotate in the plane in which it lies by the housing containing it, the universal joints permitting of this. Consequently it will cause the pistons to move in and out of the barrel cylinders, so that during half a revolution oil will be pumped out of the cylinders, and during the other half revolution oil will be sucked into the same cylinders. The oil must necessarily pass through the valve plate ports to the motor, on the pistons of which it will produce a corresponding movement. But the motor socket ring being permanently set at an angle, when the pistons are forced out the pressure on the inclined ring causes it to rotate. Thus the oil constantly circulates between the pump and motor under hydraulic pressure and serves as the working fluid The greater the tilt of the pump socket ring, the more rapid the flow of oil and the more rapidly the motor shaft rotates.



Application of the gear to an electrically-driven capstan

In a set of gear tested by the writer an electric motor was coupled to the pump shaft and run at a thousand revolutions a minute. The pump socket ring was then sligntly tilted and the motor shaft ran at one revolution a minute From that, by increasing the tilt, the motor shaft was speeded up to a thousand. The socket ring was then tilted in the other direction, the speed of the motor shaft gradually slackened down to zero, and the same procedure was gone through with in reverse

An efficiency of 85 per cent is obtained at full-speed transmission. This efficiency drops slightly down to half speed, and then more rapidly at lower speeds.

It will be clear from what has been said that, if we couple the pump shaft to an engine shaft, and the motor shaft to any other shaft to be driven, the variable speed gear provides a neutral position and also enables any desired speed in either direction, from zero to medium speed, to be maintained, according to the load It has already been explained that the pump and motor units may be placed in any convenient position and connected by a pair of oil pipes that virtually take the place of shafting It is obvious then that the gear is eminently suitable for use with alternating electric motors for which elaborate means have to be provided to enable them gradually to take up the load. Again, it should often obviate the necessity for the totally enclosed type of electric motor, necessitated in certain cases by the fact that motors have to be coupled up to the machines they drive. With the variable speed gear the electric motor and pump can be placed in any convenient position and the oil motor in any exposed position desired.

Another of its uses is as a hydraulic pump. A suction pipe from a reservoir to the pump unit would keep it supplied and enable it to be used as a variable speed pump for hydraulic work generally, its output being automatically controlled if required.

But of all uses, its application to automobiles appeals to one most. Let us consider why Firstly on an ordinary motor car we have the clutch—at best a crude apparatus. Secondly there is the gear box, with its arbitrary steps in speed, that requires skill and practice to manipulate properly and without nerve-racking noises as when the gears refuse to mesh under the hands of a beginner or an unskilful person. Thirdly there is the cardan shaft and a number of universal joints requiring frequent attention. Fourthly there is the cardan-shaft brake with its attendant levers. Finally there is the back-axle gearing and differential. What can be said of a device that will eliminate all the above-mentioned objectionable features in automobiles? For that is what their experiments lead the makers confidently to anticipate.

A pump unit will be coupled direct to the rear end of the engine shaft, a pair of motor units will be placed in alinement at the back axle, with oil pipes between them, and the pump unit, and each oil-motor will drive its own wheel shaft. Instead of differ-

(*Continued on page 376*)

The socket ring of the new gear

Clever Contrivances of the Garage Man

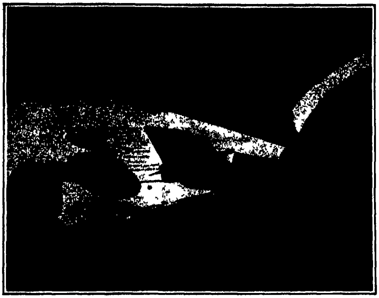
ALL specialized trades in which the machinist figures at all present scope for the inventor to provide special tools and fixtures for doing very special jobs in a fraction of the time that would be required were these tasks to be performed on standard lathes, drills, or other apparatus. In no other line has this tendency gone further than in automotive construction and repair work, and in no other are the devices of the sort suggested in wider or more general use. That the factory would have gone in rather heavily for this sort of thing is far from surprising, but that the garage repair-shop can and does afford such a variety of special equipment would be a surprise to one who had not clearly visualized the enormous saving in cost which enables a machine to pay for itself despite that it is used but once or twice a day.

A San Francisco garage was invaded by the SCIENTIFIC AMERICAN correspondent some time ago, and at least three machines found which earned the attention of the reportorial pen and the reportorial camera. The first member of the group below is a stand for testing and adjusting differentials. This clever outfit is so arranged that it gives information about the differential which, in its absence, could be got only by repeated road trials of the car, with dismounting and readjustment of the rear end between every two trips. At the right is seen the variable-speed motor that drives the differential undergoing test. At the extreme lower left is seen the foot-lever for the prony brake which applies a retarding force to one side of the differential, and enables the operator to watch the complicated gearing in action. Not alone in working economies, but in the absolute satisfaction with which differential adjustments may be made, this assembly is of extraordinary value.

Every owner has, at one time or another, had electric trouble of a nature requiring the testing out of one or more of the circuits on his car. Sometimes this has entailed an actual dismounting of portions of the car and carrying of them indoors to the testing apparatus, at the best it has involved a good deal of inconvenience in bringing the testing apparatus to the car. Here we have the better way. A battery is mounted in a wheeled box (the wheels may be just made out, where they peep from under the edge). In addition to the wheels, the box carries on its under side a cradle making it easy to set it down on the framework of the car, or anywhere else for that matter. The lead wires of the battery actually serve as "reins", the mechanic drags the battery about by them, and in a jiffy he has it right at the spot where its aid is required to learn the electrical condition of the car.

The third view shows the portable tool racks which follow out more or less the same idea as does the portable battery. Each of these stands has three racks, enabling it to carry practically all the hand tools likely to be required on any repair job. They wheel about from place to place, so that the busy mechanic always has his tool kit at his elbow, and is able to dispense with repeated trips to the other side of the building to get them.

The same garage has a clever way of testing headlights for conformity with the law—which must be more strictly enforced in California than it is in the average eastern state, if any necessity is ever felt for checking up a car's compliance with it. On one end of the building have been painted a series of vertical and horizontal lines, with two dots. The vertical line is in the correct position for centering the automobile whose lights are under examination. The two dots are then in such place as to correspond to the exact centers of the lamps. The line on the floor marks the distance from the wall which the lamps should be for the test, and the horizontal mark on the wall indicates the dead line above which no light from the lamp should fall. This is sufficiently clear without a photograph, and equally clear it is, that with the lines properly arranged the assurance may be had that any lamp meeting the above conditions meets the state law.



This circular computer is presented as an improvement upon the conventional slide-rule

A Circular Slide-Rule

ALL technical calculations require answers to an accuracy consistent with the data 2, 3, 4, or in very fine work, 5 significant places. For this purpose the graphic-log method is by far the best. But the shrinkage and warpage of the ordinary wood-celluloid slide-rule, make it unreliable, while its scales require months to master. A new, all-metal, circular computer that utilizes the logarithmic principle, but is built like a transit or compass, and convertible for desk or pocket, has been recently perfected by Louis Ross, a civil engineer and ingenious inventor of San Francisco.

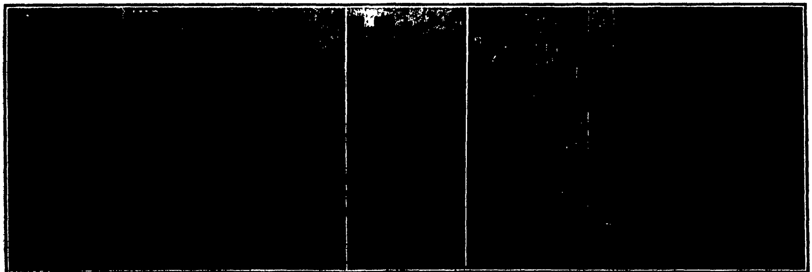
This computer is shown in the illustration. It consists of two scaled, rotating dials, read by a radial hair-line engraved under the lockable arm. The computer is five inches in diameter, while the inner dial is four inches, so that contact scales are 12½ inches long, like upper scales of a 25-inch straight rule. The outer and inner dials of the computer are analogous to the upper and lower movements of an engineer's transit, a thumb-lock, as on a transit, controls the outer dial, while a special desk-clamp serves, like a tripod for the transit or compass, to increase accuracy and convenience, and to permit one-hand operation, leaving other hand free for writing down results. Double readings, answer and proof, like the double verniers on a transit, eliminate mistakes and errors, instrumental and personal. The dials are graduated directly on heavy metal, fine as a transit, but in purple color easy to read and soft to the eye. Made wholly of metal, the computer is unaffected by heat, cold, dampness.

The magnifier, adjustable in focus, radius and direction, makes readings appear larger than ordinary typewriting, increasing accuracy of interpolations. When direct, less precise readings are desired, a touch of the finger turns the magnifier aside, and it is instantly detachable for separate use. The use of either magnifier or desk-clamp is optional, both are instantly detachable. The loose-leaf leather case, supplied with standards 3¾ x 6¾ sheets, in a variety of rulings and forms, folds to 5 x 7, so as to fit coat, breast or back pockets.

The key for operation is given on the arm, in plain sight of user. When any problem is set under the hairline of the arm, a long arrow automatically points to the answer, while a short arrow shows the proof. If the problem involves three items, two knowns are set opposite each other, and opposite the third known the answer appears. Repeat numbers, or "constants," can be locked, so that they will not shift accidentally—a great convenience in heavy, tabular work. Trigonometric, logarithmic and exponential problems are solved just like plain numbers, by using the special scales as labelled on the arm, for that purpose.

Stave Trade in Foreign Countries

FOR the benefit of American cooperage exporters, the Lumber Division has just issued the publication "Stave Trade in Foreign Countries." This is a compilation of reports from American consuls and representatives of the Department of Commerce in various foreign countries. Being replies to a questionnaire sent out by the division, these reports cover the importation, domestic manufacture, specifications, and uses of cooperage, as well as indicate how the import trade is handled. In addition, statistics on the cooperage exports of the United States and imports and exports of other countries were prepared by the division. Statistics on United States exports for 1922, which were only recently available, have been added as an appendix.



Left: Stand and motor for giving the differential a test which otherwise would have to be made on the road. *Center:* Battery arranged for maximum ease of portability in connection with electrical tests of the car; *Right:* Insurance against time lost in going for tools

Some of the ingenious special fixtures with which the labor item is cut in the up-to-date garage

Fish as Food and Fertilizer

How the Annual Catch of Over Two and One Half Billion Pounds Is Disposed of as Fresh and Frozen Food, and Fertilizer for the Farms

EVERYONE who has given any thought to the subject must have realized that the fishing industry of the United States was prosecuted on an enormous scale, but it will be news to many of them that the annual catch is over 2,000,000,000 pounds of fish. Analyzing the distribution of catch in millions of pounds, we find that the Middle Atlantic states stand far in the lead with a total catch of 804,000,000 pounds, followed by the New England states with 467,000,000. South Atlantic states, 333,000,000, Alaska, 312,000,000, Pacific coast states, 293,000,000, the Mississippi River division, 148,000,000, the Gulf states 131,000,000, the Great Lakes with 104,000,000 and Lake of the Woods and Rainy Lake with over 2,000,000 pounds of fish.

An enumeration of the multitudinous craft and the diversified gear which are used in recovering this rich store of food from our seas, lakes and rivers would make a story in itself, and we must be content just now, to state that the total tonnage of fishing vessels reaches the large figure of 69,555 tons, the total number of men employed is 200,000, and the cost of the equipment is $184,121,711. Our artist has endeavored to present this figure in concrete form by the accompanying picture, showing the 55,000-ton "Leviathan" with a typical Gloucester fisherman of nearly 70,000-tons displacement drawn in as a background.

If you ask the average citizen what becomes of this great catch of fish, he would probably tell you that it is landed as quickly as possible, brought with all speed to the table and eaten as fresh fish but he would be altogether wrong as a single glance at the accompanying drawing will show. As a matter of fact, just one-third of the total catch consists of fish known as the menhaden, which is so full of oil and of such a flavor as to be unsuitable for the table. It is eaten only in certain locations, and then only by the poorer people who cannot afford to pay for fish of a better quality. The menhaden is not caught on the Pacific coast but it is found in supreme abundance off the Atlantic coast where the total catch according to the latest figures, was 880,543,339 pounds. These fish travel largely in shoals, and are caught by seining and in traps. They are taken to various plants scattered along the coast, where they are cut up and the oil extracted, the residue being dried and ground to form the fertilizer of commerce.

The best known of the eatable fishes is shown on the accompanying engraving, in which the total catch in pounds and its total value is shown upon each specimen. These are the mackerel, halibut, cod and the weak fish, while the canned fishes shown are the salmon, sardines and the tuna fish. Our artist also shows the lobster, the crab and the oyster. The whole story relative to amount and values is so clearly presented as to need no other comment, further than to point to the enormous dimensions to which the canned salmon industry has grown, with its total canning of 161,643,380 pounds valued at $26,761,000.

We have spoken of the freezing of fish for food, and this is one of our rapidly expanding and vital industries. We must inevitably greatly amplify this business if we are to make the most of nature's well nigh inexhaustible supply. The finny creatures are rich in nitrogen, which is essential to a well balanced diet and, therefore, to our bodily fitness.

Our fishing fleets, as we have noted, have taken from our waters in the course of a year over 2,000,000,000 pounds of fish. Goodly measures of certain species are canned, smoked, salted or otherwise preserved, but the largest part of these catches is sold and consumed promptly, while a lesser but very important percentage is put away in cold storage where it is held for months. According to the latest statistics available, there were frozen in the United States in 1920, fully 85,824,308 pounds of fish, with halibut, herring and whiting heading the list of some forty-odd varieties.

As most of us are aware, fish can be packed in ice, provided plenty of ice at moderate cost is at hand, and they can be sent afar from shipping points and arrive unharmed and palatable if the weather is favorable. This has been done even in the summer time, when special precautions were taken, and fish have in this way been dispatched inland a distance of 800 miles without suffering deterioration. As a common thing, however, this procedure is not resorted to during the warm months, except for distribution within a much more limited zone. Packing fish in ice does not lower their temperature below 32 degrees Fahrenheit, and this, in itself, does not suffice to preserve them for long in a prime condition. Consequently, freezing is employed instead, and there are more than a hundred establishments in the United States now engaged in this business, which does much towards lessening the cost of living.

The fishing fleet of 69,555 tons compared with "Leviathan" of 55,000 tons. Total equipment costs $184,121,711, and 200,000 men are employed

It may not be generally known that fish, when fresh from the water and promptly frozen, may be carried in refrigerator cars anywhere within the length and breadth of our land. The best proof of this is that all but 10 per cent of the fresh halibut consumed by us originates off the shores of Alaska. Before the World War frozen salmon from our West coast was eaten extensively even in Western Europe, where it sold readily at good prices. Much of the fresh salmon for our tables comes from the same locality. There would not be the demand for this comestible if the freezing of the fish rendered them flat in flavor and less desirable, judged by the standards of strictly fresh fish.

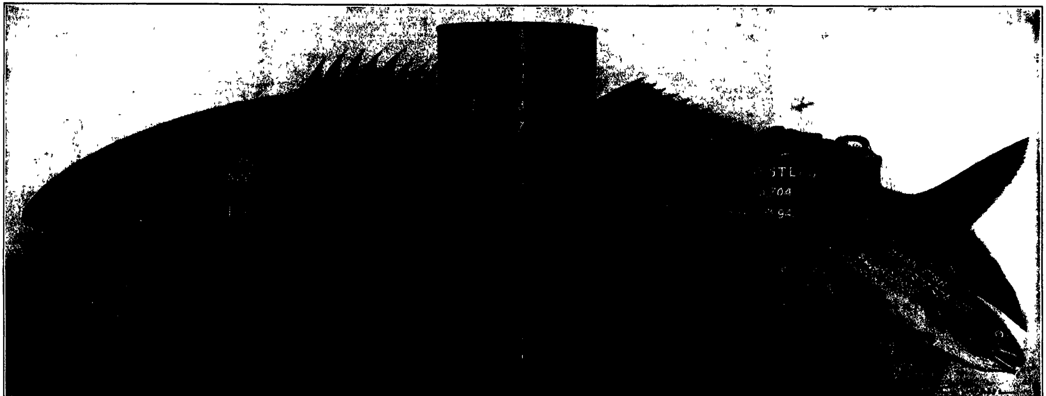
The process of freezing fish is an adaptation of artificial refrigeration designed to preserve an extremely perishable foodstuff, commonly taken from the waters in mild or warm weather, so that it may be at our disposal in the winter months especially, when fishermen cannot venture forth upon the stormy seas. It is also intended to permit the fisherman to reap a harvest when 'the run is on,' and to make it feasible during the days of plenty to store away some of the abundance for consumption out of season.

As a rule, the frozen stock is carried in cold storage from six to twelve months, the greatest volume being disposed of within from six to eight months after freezing. However, the longest of these periods is relatively short when compared with certain tests conducted by the Federal authorities which proved that frozen fish could be held for 27 months. At the end of that time elaborate analyses of the fish failed to show that any changes had taken place which would render them at all unsuitable for food, or to indicate any important differences in chemical composition between these fish and fresh fish or fish stored for shorter intervals. As soon as a catch reaches the plant, the fish are washed with cold, running water to free them of dirt and slime. Next, depending upon the size of the fish, their nature, and the requirements of the market, they may be split and cleaned before undergoing freezing. Generally fish that are heavy feeders, that eat freely of animal matter, or that are rich in oil, are eviscerated to insure their better keeping in cold storage. It is impracticable to gut such species as butterfish, bass, small mackerel, etc. These are usually frozen in their natural state after they have been put in pans capable of holding about 40 pounds of the foodstuff. Ordinarily a pan contains a single layer of fish, placed spoonfashion, head to tail, and when the pan is filled it is set upon the shelf of what is known as a "sharp freezer." The temperature of the room ranges between 5 degrees to 15 degrees below zero Fahrenheit. The fish remain on the shelf only long enough to freeze them through and through, and the quicker this is done the more palatable the fish in the end. Rapid freezing is, therefore, preferable.

Large fish like halibut, salmon, black cod, are seldom handled in pans but, after washing are laid right on the shelves of the sharp freezer and are frozen separately. They are then as hard and solid as stone. Whether panned or frozen singly, fish require anywhere from 6 to 24 hours to put them in the desired condition. A thick fish, naturally, takes longer to freeze through than a thinner one.

The next step in the process of preservation consists in giving the fish an icy coat or glaze and the manner in which this is done is of importance. Glazing is designed to encase each large fish or each block of frozen small fish within an airtight envelope of clear ice. Unless so glazed, the skins of frozen fish are liable to turn white while the bodies shrivel owing to loss of moisture induced by evaporation even at freezing temperatures. Glazing prevents the evaporation of the moisture from the flesh of the fish, prevents the entrance of air which tends to make the fish oils deteriorate, provides an ice surface upon which molds and fungi cannot grow, and, finally, helps to protect the fish from mechanical injuries.

The temperature of the glazing room is in the neighborhood of 20 to 25 degrees Fahrenheit. On reaching this room the frozen fish are put quickly through a trough of clean, clear water which is at or near the freezing point. This water forms a thin film which solidifies well nigh instantly in the cold air of the room. By passing the fish through the water from three to five times this protective coating is built up until it constitutes a sufficiently heavy veneer of ice which covers the entire surface. In the case of the canned fish during glazing and before the accumulating ice has gripped the fish in a solid cake, the fishes are held together by the freezing of the first thin layer of water between them, and the additional glazing still further cements them to each other thus guarding them against any movement during subsequent handling which would be apt to damage them. From the glazing room the fish go ultimately to cold storage.



The annual catch of the leading varieties of fish in the United States. The total is over [illegible],000,000 pounds. Its value is $84,401,184. Its cost to the consumer is $211,962,960

Feeding the Automobile Engine

Purdue University Investigation of the Proper Treatment of Mixture that Goes to Carburetor

THE FUEL problem is no longer merely that of finding a supply of light combustible hydrocarbons, it is that of an insured supply of any liquid fuel at a proper price. The public has ceased to ask for light and volatile fuels, and is asking merely ordinary combustibility and a reasonable cost.

We are told that we have in sight only a ten year supply of gasoline. The situation is not quite so desperate as this, for we shall undoubtedly develop new sources and new fuels. But in view of all the known factors, it is necessary to conserve fuel and to utilize fuel with a minimum of wastage.

Car, truck and tractor must today use the heavier fuels and leave the lighter ones for the plane. These heavy fuels grow heavier each year, they continue to burn in our cars, but with a long tale of low efficiency excessive repairs and maintenance, and short life. We sometimes ask whether the Otto cycle is permanently suited to the fuels of today and tomorrow.

The Otto cycle may ultimately be replaced, but for the present it is the one in universal automotive use. The immediate attack upon the fuel problem lies in the practical use of all available data regarding fuel combustion. Formerly the light fuels required no heat beyond the sensible heat of the intake air. Today, even with decreased manifold pressures the atmospheric temperature is inadequate and heat must be added. Much hinges about the best way of effecting this addition, six different procedures may be identified.

Preheating the fuel for the sake of a dry mixture is useless, it interferes with metering at the nozzle. Moreover, what is needed is the heat equivalent of vaporization, after the boiling point is reached, and in no event can we raise the temperature of the fuel above the boiling point of its highest fraction.

Preheating the air is very useful on the cars now in operation. It does not interfere with carburetion but cuts down volumetric efficiency and power delivered. It gives good mileage, smooth running, elimination of oil dilution, lean mixtures with freedom from carbon deposit. The main objection is the decreased power output and the slight decrease in thermal efficiency at the higher temperatures.

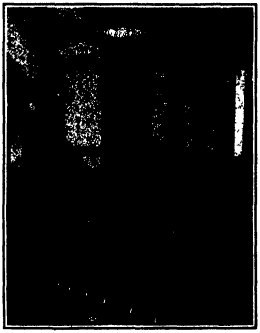
The advantages of *preheating the fuel and the air* are principally those derivable from heating the air alone. Again the fuel must stay below the boiling point of its lightest fraction. No heating of the fuel is advisable, beyond that which necessarily occurs from the heated air, unless a device is used that is peculiarly adapted to metering control.

From the theoretical viewpoint, *heating the mixture* has advantages over the preheated-air method. Heating is achieved at lower pressures, and the degree of heat may be more variable without affecting the carburetor. If the minimum temperature is sufficient for idling, the maximum will not cause bad effects at higher loads and speeds. If skill is not exercised in the design and placing of the heating surfaces, however, the power loss is as great as with the preheated air method.

Heating the fuel after metering is more nearly the ideal method, possessing the good points of heating the mixture and being free of the bad features of the other ones. Having been metered, the fuel may be completely vaporized if necessary. The temperature of the vaporizing surfaces, when exhaust heat is used, never ignites the fuel. The air is barely heated at all, while the fuel is wholly vaporized. When the two are brought together, the temperature of the final mixture approximates closely to the theoretical minimum, so the power loss is insignificant. Again care must be exercised in design, and wet portions of the fuel must be allowed to pass through the separating device or acceleration will be accomplished only with a lag.

Heating the fuel and part of the air after metering is a modification now in use in some cases. The final temperature of the mixture may be quite low without excessive deposition. A very delicate metering device must be used, however, and as vaporization is entirely from the heated walls of the hot area, the temperature of these must be very high.

The Engineering Experiment Station of Purdue University has made extensive tests to show the relative merits of preheated air and of the various hot-spot methods which comprise the alternatives, as well as to bring out all possible data regarding fuel preparation and combustion, fuel-air ratios, etc. The accompanying illustrations show in some detail the apparatus used in these tests. The engine was direct-connected to an electric cradle dynamometer through a suitable universal joint. Means were provided for measuring all temperatures, pressures, etc., and all tests which were to be compared in any series were made with the same throttle opening and load. In testing the "hot-spot" operations the hot spot was of experimental design, heating at the outside bend of an enlarged intake pipe. An inspection glass of ample diameter was placed at the top of this section, so that the spot could be easily observed, and the dryness of the mixture and the size of the fuel globules noted.



The fuel is weighed on the balance and siphoned from beaker to carburetor. The panel at the left provides electrical means for controlling measurement of speed, time, air and fuel. The switchboard at the bottom provides means for regulating voltage from 2 to 32 volts, giving flexibility of operation

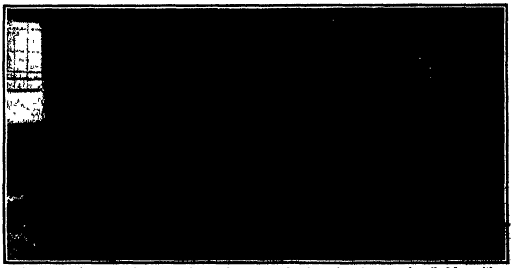
The details of the control table

In general terms, these tests showed that with suitable attention to the best operation of our automobiles and trucks, at least 25 per cent of the fuel used in the automotive industry could be conserved. This would come to 1,362,500,000 gallons, worth, at current prices, some $300,000,000. This estimate is conservative, it represents the minimum saving which might be effected with the vehicles now in use. With accurate data on the numbers, types and weights of these, the saving would no doubt work out at a higher figure.

It is not alone the fuel that is wasted, but this loss indirectly leads to other complications. Poorly and partly burned fuel causes oil dilution, excessive carbon, and hence high upkeep and high depreciation. The unnecessary charge under these headings for the entire United States is at least a billion dollars annually. Applying the results of these tests to individual cars, substitution of correct for incorrect operation has in numerous specific cases increased gasoline-mileage anywhere from 40 to 250 per cent. It is believed that at least half of the cars now operating are susceptible of material improvement in fuel utilization.

In support of their conclusions that the hot-spot method affords the best prospect of meeting future conditions, the Iowa engineers refer to the fact that while much has been published concerning the power losses due to excessive heating of the charge in a vaporizing manifold, less attention has been diverted to the fact that as much or more power loss is possible from the decrease in volumetric efficiency that follows from poor selection of heating surfaces and unfavorable temperature of these surfaces. With the very crude experimental hot-spot used in the tests, a metal temperature of 590 degrees at the hot-spot gave a dry mixture at half load with an intake pressure of 11 inches of mercury. Why, then, cannot the performance be satisfactory at low speed idling with a metal temperature of 300 degrees and 20 inches of vacuum? The problem of manifold design resolves itself into the one of fundamental data on rates of fuel vaporization at various temperatures, temperatures available from the exhaust at all operating conditions, and the vaporization of the fuel in its relation to distribution to the several cylinders, and the utilization of ingenuity in the design of the vaporising surfaces. If more analytical methods were substituted for the out-and-try procedure so largely in use heretofore, some of these problems would not assume such large proportions.

Engineers concede that the fuel of the future will be heavier than that of today. This granted, the statement can be made that manifolds will satisfactorily vaporise and distribute the mixture as well as is done today, or better. The big handicap now and in the future is starting. When a starting device is used that will immediately deliver the mixture sufficiently dry to the cylinder, no apprehension need be felt with regard to the good performance of the engine after it is warmed.



The engine, air-heater, air-meter and control apparatus for the carburetion tests described herewith

Street Lighting

THE Bureau of Standards is making a study of the various systems of street lighting used in cities and towns throughout the country. Seven hundred and forty-four municipalities have been asked for copies of their street-lighting contracts, and 102 replies have been received so far. About 200 replies have been received on street-lighting questionnaires which were recently sent out, and very full engineering data has been obtained from 30 of the larger companies. The text of a number of the general sections of a circular on street-lighting service has been prepared in preliminary form.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

This attachment to the knife enables the hostess to serve the cake in complete safety

A Novel Cake-Server

INVENTION has come to the rescue of the host or hostess whose lot it is to cut and serve the layer cake. No special tool for this purpose is offered, but rather an attachment for the ordinary knife. This attachment, much like a two-tined fork in general outline, slips around the handle of a regular dinner knife. When the cake has been cut, the knife is slipped under it, and the fork pushed into the cake, holding it securely on the knife blade.

Oxidized Kerosene as Truck Fuel

THE solution of still another industrial problem has been undertaken at the research laboratories of Carnegie Institute of Technology, Pittsburgh, in experiments to determine the relative efficiency of kerosenes and oxidized kerosenes as fuels. In accordance with the policy of the institute to link up its educational facilities with modern industry, the Department of Chemical Engineering has been conducting a series of tests to determine the relative merits of various oils as usable fuels. The completion of this important work should go a long way toward solving the problem of oil conservation by the possible development of a new fuel. According to a report by Dr. J H James, head of the department conducting the experiments, oxidized kerosenes cause less "knocking" tendencies than straight kerosene when used in a kerosene engine. The tests also showed that oxidized kerosenes have approximately the same power development as ordinary kerosene in spite of the fact that their thermal value is one-eighth less. Dr James attributes the efficiency of the oxidized kerosenes to the better "clean up" in the combustion of these partially oxidized fuels. The success of the experimental work at Carnegie at this stage gives promise that oxidized kerosene, which is manufactured by catalytic oxidation from low grade petroleum, may become a useful fuel in the future. Its properties may cause it to be used industrially in kerosene engines or blended with gasoline for use in gasoline engines. Although it has a somewhat lower fuel value than ordinary kerosene, one of the most favorable features of its effectiveness is that it under goes much better combustion in the internal combustion engine.

Device for determining the amount of magnetic ore in concentrate

A Heat Economy

NONE of the advances of recent years in the manufacture of cement is of greater importance or interest than the utilization of the hot gases escaping from the kilns to heat the boilers that supply steam for the operation of the cement-plant power-house. For years an immense amount of energy was lost in these gases, which reached the stack at temperatures of ten to fourteen hundred degrees Fahrenheit in plants using the dry process of manufacture.

Many problems stood in the way of utilizing this heat, but great progress has been made, with the result that a number of plants are now producing from 50 to 100 per cent of their power requirements through waste-heat boilers. Such installations require heavy expenditures, but the adoption of this means of saving fuel will undoubtedly become more general as time goes on.

These waste gases consist largely of nitrogen from the air that furnished oxygen for combustion in the kilns and of carbon dioxide driven out of the lime stone during the burning. In plants employing the wet process, waste-heat boilers have been installed and have resulted in important savings.

Magnetic Assaying

THIS device is used for quickly reducing a sample of ore so that the magnetic iron percentage can be accurately computed. A sample of ore is placed in the glass tube which has been previously filled with water. The carriage and tube are then automatically rocked, the carriage bearings being placed at the poles of the magnet. A stream of water passes through the tube, washing away the tailings from the concentrate, which is held at the poles. When the washing is completed, the magnetic assay is made.

The Latest Auto Lock

HEREWITH is illustrated one of the latest devices for defeating the automobile thief. It consists, as the picture indicates, in a simple lock that is attached to the steering column, beneath the wheel. When locked two plungers project upward and firmly hold a spoke of the steering wheel between them. Lock and plungers are of drop forged, case hardened steel, heavily nickeled, the lock itself is a cylinder affair of the familiar model. The lock is so constructed that it will not rattle, and there is no danger of its falling into locked position while the car is running.

By means of projecting plungers that engage a spoke of the wheel, this lock makes the car secure

A Magnetometric Method of Determinating Carbon in Steel

AN interesting account of a magnetometric method for determining carbon in steel was presented by Gunnar Malmberg at the recent annual meeting of the Swedish Metallographic Society. The new method is based on the fact that the magnetic properties of steel undergo a striking change as the percentage of carbon is altered. Though even other components of the alloy exert an effect of their own, this is, as a rule, incomparably smaller and, accordingly, does not greatly affect results. Moreover, inasmuch as Mr Malmberg has accurately studied this effect, it is readily accounted for. An apparatus designed by the experimenter and known as carbometer enables this method to be applied to the testing of steel samples in actual practice and, being both rapid and reliable in working has been adopted by some of the leading Swedish iron works for checking the progress of steel refining.

Soldering Without a Soldering Iron

SOLDERING without the use of a "copper" produces neat and rapid results, says *Sheet Metal Worker*. The method is to heat the parts to be soldered, by means of a torch flame, until they are just hot enough to "sweat" in the solder and not hot enough to make the solder run off. The ability to get the correct temperature comes with practice. A small, compact flame is best. Wire solder is employed, with the usual flux, and an acid brush. The surface to be soldered should be kept horizontal.

If gobs of solder form, they may be wiped smooth with the acid brush and the surface heated again, but when skill is acquired, the brush can be dispensed with altogether. No wiping cloth is needed. The only drawback to the method is that considerable practice is necessary to become skilled with it. However, not only is it much more rapid than the usual way of soldering with an "iron," but for some kinds of work the results are much more desirable. It is particularly effective where smooth soldering is wanted as for example in the gasoline tanks of automobile touring cars but where it would not be advisable to file off the surplus solder because by doing so you would be very apt to scratch the surface of the metal itself.

Wood Poles for Transmission Lines

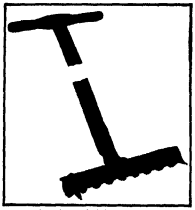
A GERMAN firm has lately put on the market a type of wood pole, which should have a life of at least 40 years. The upper portion is of the usual kind while the base is of impregnated hard wood. Experience shows that impregnated beech wood sleepers have a life exceeding 37 years and as poles are not subjected to the same mechanical shocks, the makers anticipate a longer life than this for their poles. The two portions of the pole are bound together by wrought-iron strips, which are bolted together.

The Window Bed

NO longer is it necessary to provide an expensive sleeping-porch for the benefit of those who need fresh air at night.

The window bed here illustrated can be rolled out of any window, with perfect safety. It is in reality a completely screened cot, mounted on a metal frame and supported from the floor much as

Sleeping out of doors without a sleeping porch



The simplified lawn-mower

small iron beds are supported. When rolled on its frame out of the window, it is held in place by chains. For camping the bed like frame is not used, the springs resting upon the supports that hold them to the frame of the house. Under such circumstances, the sleeper is about six inches from the ground.

Keeping the Kitchen Range Bright and Shiny

POLISHING the kitchen range is not so essential as keeping it oiled against the invasion of rust. This fountain brush cleans and oils at the same time, the flow of oil being adjustable from the oil container which is in the top of the holder. A slight pressure of the thumb on the plunger, as illustrated, gives regulation to the precise amount of oil desired.

Funnel, Filter and Dipper in One

THREE kitchen utilities in one is the convenience now offered the housekeeper whose space is limited. Funnel, filter and dipper are consolidated into a single tool illustrated doing duty as a funnel. For conversion into filter or dipper the circular attachments are used which in the photograph are shown leaning against the bottle. Two of these are of wire screening, one coarse-meshed and one fine, when placed at the entrance to the tapering part of the funnel, they obviously convert it into a filter. And when it is to be used as a dipper the solid plug is used in their stead and the contents of the bowl instead of running through, stay in.

The insertion of one of the circular plugs converts this funnel into a filter or a dipper

A Simple and More Compact Lawn-Mower

A GREATLY simplified lawn mower has been recently introduced by a Michigan manufacturer. It is claimed that the device cuts and trims both tall and short grass at the same time. It is lighter in construction than the average lawn mower, weighing only seven pounds. Because of the fact that there are no large wheels at the side, it is possible to cut grass around trees, shrubbery and along embankments much better than formerly and this eliminates the necessity of hand cutting and trimming.

The mower drives in much the same manner as other types, having a long T shaped handle which is solidly set. The cutters consist of sixteen small gear-shaped wheels but sharpened. Eight cutters on a side interlock and insure that the grass is cut evenly wherever

Convenient device for cleaning and oiling the kitchen range

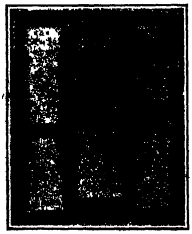
the mower is guided. The cutters are adjustable so that the grass may be cut to any desired height. At the sides are two small wheels, only two inches in diameter. These serve to guide the mower and take the place of the larger wheels used on other types of mowers. These wheels have geared tooth edges which secure a hold for the mower in the dirt. Just in front of the wheels are two guards with pointed ends which serve to guide the operator of the mower and insure that it will be held at just the right angle to get the best results. The cutters do not need resharpening, but can be replaced at a small cost.

Solving a Printing Problem in the Composing Room

TYPICAL of a certain printing problem that often arises is the conventional check book of large size, with three checks on a page. It has always given the printer the option of setting up the check three times or of printing three impressions upon the sheet, one after another, from the single plate. The first alternative is obviously an expensive one; the second introduces the further complication of getting the second and third impressions in exact register.

A blind inventor of Fort Worth, Tex., K. J. Dollahite, has steered a successful course between Scylla and Charybdis. He has designed a compound "chase"—this word, we should explain to the uninitiate, standing for the metal frame in which the compositor locks his type before sending it to the press. Mr. Dollahite's chase consists of an outer frame and an inner one. The outer chase serves merely as a track for the inner one to move in. The inner one carries the type, which is set but once for the three (or more) impressions. The inner chase is mounted in the outer one by micrometer screws, so pitched that one complete turn corresponds to a spacing of one pica. Thus it becomes possible, after a single impression has been run off with the inner chase in its upper position, to screw it down to an intermediate position and run the sheets through again for the second check, without a thought for the problem of register, which is now solved automatically. And in the same way, the inner chase is screwed down all the way for the third and bottom most impression.

We have described its operation only for the case where three identical printings are to be made, but obviously the chase can be built for any desired number.



The adjustable, three-positioned chase that cuts the cost of printing checks, three on a page

The Circular Washboard

KITCHENETTE housekeeping is brought one step nearer the ultimate goal of simplicity by the washing outfit illustrated. The washboard is made circular in section, and a pail supplied of corresponding radius. For washing the two are fitted together as in our illustration for storage or packing they are left that way, and when the bucket is needed as a bucket, the washboard comes out. With the aid of this combination and a chair, one washes with convenience equivalent to that given by the stationary washtub.

Photography Makes Charred Manuscript Legible

AN important discovery, which practically solves the problem of restoring written or printed records made illegible by the carbonizing effect of heat under partial exclusion of air, has recently been made by M. R. Davis, one of the research workers of the Bureau of Weights and Measures in Washington, D. C.

Handwritten, typewritten and printed sheets of paper were used in the experiments. They were subjected to conditions similar to those to which documents enclosed in fireproof safes are exposed during a big fire. Enclosed in a nearly airtight container of fireproof material, these papers were subjected to a high temperature, until they were carbonized. When removed from the container, the papers were completely charred and neither the writing nor the printing could be deciphered.

Mr. Davis, placing one of the carbonized sheets between two photographic plates and leaving them undisturbed in darkness for two weeks, obtained clear and perfectly legible negatives of the writing and printing on both sides of the paper. Both plates showed strong impressions of the writing on the sides of the paper with which they had been in direct contact and, very faintly, traces of the writing on the reverse side. Rapid and medium plates gave the best results, while slow plates gave poor results.

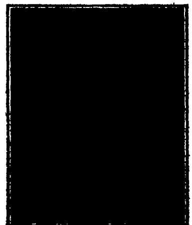
When rapid films were used instead of plates, the results were even more satisfactory. Excellent reproductions were obtained after an exposure in the dark-room for eight days. Strange to say, the writing and printing appeared on the films black, like a positive. It was learned that, with films also, negatives could be obtained, if before exposure, the carbonized sheets were carefully washed with distilled water and dried.

It is believed that the effect on the sensitive coating of the plates or films is due to the gases occluded in the carbonized paper and that the written or printed characters on the paper appear in negative because the ink acts as a screen, preventing the reducing gases from acting on the silver emulsion.

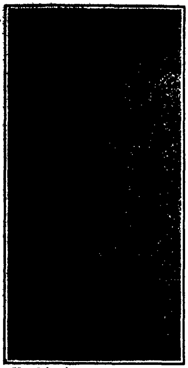
A space-conserving wash-day combination for the crowded apartment

The Flashlight Goggles

CONVENTIONAL flashlights are all open to the objection that the user must give up one hand to holding the flash, or else must rig up a temporary base for the light when the job to be done is essentially a two-handed one. This is not particularly satisfactory, since the light remains fixed upon a single point instead of following the work as it should. A very clever escape from this predicament is seen in the flashlight illustrated, attached to a pair of goggles. The lamp is between the lenses, where it is out of the line of vision, and a shield is provided to protect the eyes from the light. Electric energy is supplied from a battery, not immediately attached to the lamp, but in the user's pocket and joined by wire to the lamp. Obviously, the light must shine upon the precise point at which the wearer's gaze is directed.



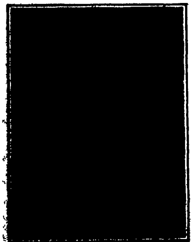
The flashlight that must shine upon the place where the worker is looking



Novel hand-power vacuum pump

A Gas Mask for the Miner

GAS MASKS have been used in several of the industries since the example of the World War taught some four millions of Americans their efficacy against poison gases. Firemen are now regularly equipped with them. Now comes one for the miner, called the "Self-Rescuer" Obviously, it is not the exact model used in the trenches. The miner has no need of one so elaborate and cannot be bothered with one so clumsy But a manufacturer in Pittsburgh has put on the market a small though efficient mask that may be carried on the belt of the workman and which will not get in his way or be so bothersome that he will neglect to carry it. Ex-service men will smilingly recognize the old mouthpiece of rubber to which is attached by a string the same old nose clothespin that held the sides of the nostrils together four seconds after someone shouted, "Gas!" The rest is new The little 18-ounce canister measures only four and a quarter by three and a quarter by one and one-half inches and is filled with a chemical known as Hopcalite. This chemical converts the deadly poison carbon monoxide known to miners as "afterdamp" into carbon dioxide, which is the same non-poisonous gas that puts the fizz in soda-water



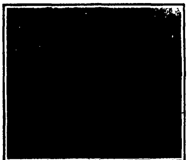
The engine thermostat that rings a warning bell

Since the necessity of using the Self-Rescuer in a mine may come but once in a lifetime, it was necessary to provide a method of protecting the canister against dirt and abrasion while worn during very lengthy periods of time Accordingly, the mask is covered with a seal of metal which may be ripped off very easily as it is attached only with soft solder. The chemicals protect against any concentration of carbon monoxide that is likely to be encountered during a period of 30 to 70 minutes.

Vacuum by Hand

FOR small work, the hand vacuum pump illustrated, which has just been put on the market, affords a very economical substitute for a power pump In addition to the standard and recognized uses for such an outfit by chemists, doctors, dentists, etc., the manufacturer suggests other fields in which it would give good service. Thus, it has been found possible to line iron pipe with lead by inserting the end of the pipe in molten lead and applying a moderate vacuum to the other end. The suction fills the pipe with the hot lead, and the latter cools where it is in contact with the iron When the vacuum is released the molten core flows back into the crucible, leaving the pipe nicely lined with lead The procedure would, of course, not be available for a long pipe length, but would do very nicely for a short one

Another application lies in the exhausting of liquids from inaccessible places—of water from a steam trap, etc The pump is practically designed with reference to this sort of thing The vacuum is created first in a glass bottle, and carried from this out along the line Anything in the way of liquids that the suction brings home will enter the bottle rather than the pump, and will stay there until the bottle is filled, hence the apparatus may actually be used to exhaust acids. The pump is supplied both with and without the gage



Gas mask that protects the miner against carbon monoxide

A Bell Motometer

THE standard motometer with its red line and its dead line above which the red must not go, is a great saver of repair bills for the careless driver But it does have to be watched, and it therefore leaves something to be done in the way of giving automatic warning of an overheated engine. The bell attachment for the radiator cap which we show takes the additional step Wound by hand as shown on the illustrations, the bell acts as a thermostat, the spring is released when a certain temperature is released, and only a totally deaf chauffeur has any excuse for not knowing that trouble awaits him if he doesn't stop and investigate.

Carrier Current Makes Long-Distance Lighting Possible

EXPERIMENTS made at the plant of the General Electric Company at East Lynn, Mass., proved, according to officials of the company, the practicability of sending high frequency carrier current, such as is used in radio communication, over electric light feed circuits to light relay lights as far as four miles away from the generating source of the current.

Ordinary 110-volt household lighting current was converted into carrier current by means of a high frequency generator The output was superimposed upon the 4400-volt house lighting feeder current running from the plant to Nahant, Mass., four miles away

Two relays of electric lights at the Nahant end of the line were set to different carrier frequencies. When the carrier current frequency coincided with the attunement of one relay of lights they would light up. But when the carrier frequency was attuned to the other relay its lights would glow The carrier current was transmitted over the lines without interfering with regular lights.

Tests have shown, according to the company, that any number of relays of lights attuned to different carrier current frequencies can be operated individually

Coil-spring shock absorber of unusual pattern

Another Shock Absorber

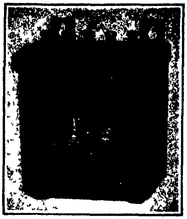
SHOCK absorbers are offered in numerous styles, but few are designed so as to become so integral a part of the suspension system of the car as the one here illustrated Taking the place as it does of the spring hangers and of all other connection between the spring and the car, it has the direct effect of adding to the length of the spring. Nor is this addition measured by the mere overall dimensions of the device, by virtue of the positive action of the coil spring, the car spring works like one several feet longer than is actually the case In addition to the coil spring with its cushioning effect the device includes also a very effective rebound check

Getting at the Milk Bottle

FILTHY as it was, the old fashioned tin cap for the milk bottle, with its spring clip, was always easy to get off, and it never gave the housewife a milk bath as an incident to its removal Ever since recognition of its unsanitary character forced it to yield the floor to a card or paper cap that is used once and then discarded, the problem of easy and safe removal of the latter has been plaguing our inventors The solution which we show at the bottom of the adjoining column appears to have merit An aluminum cap the size of the bottle-top has two sharp prongs on its under side It is placed over the bottle-top, the prongs necessarily piercing the paper cap. Then it is tilted off, and necessarily it brings the paper cap with it, while acting as a shield against the geyser of milk which sometimes comes away with the paper

The Crossing Signal That Cannot Fail

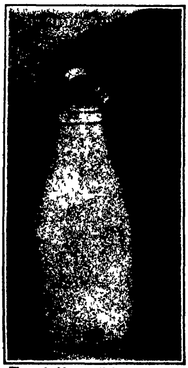
REQUIREMENTS for an electric signal protecting a railway grade crossing are severe. It must be capable of alternately opening and closing two electrical circuits many millions of times, without a change in the contact adjustments and without causing rapid deterioration of the contacts. The most recent attempt to meet this demand uses a totally different principle from its predecessors, instead of an exposed contact, these members are enclosed in a glass tube partly filled with mercury and inert gases.



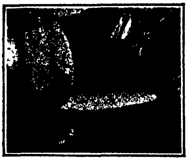
The working parts of the grade-crossing signal that can fail only on the side of safety

This apparatus consists primarily of an armature, oscillating freely between the poles of an electromagnet To this is fastened a pendulum, which is oscillated in one direction by the electric current, whereupon the current is automatically turned off and the pendulum returns to its original position gravitationally This cycle is repeated automatically from 30 to 60 times per minute. On this pendulum is mounted the contact tube mentioned above

Without going into too great detail, it may be said that the contact is made in the mercury when the pendulum is in either extreme position, and broken while it is swinging from the one to the other The device controls two (or more) red lamps, in such a way that first one then the other lamp is lighted. These lamps are in such positions along a circular arc at the crossing that their successive flashing gives the effect of a single red lamp, swinging back and forth And the device meets the requirement that if it fails, it must fail on the side of safety for if the pendulum ceases to oscillate, it must return to the vertical



The splashless milk-bottle opener



The coiled spring in this driving cushion gives resiliency and ventilation

position under the pull of gravity Then one of the contacts remains permanently closed, and one or more of the red lamps burns continuously

It will be understood that this signal works only when a train is approaching, the track relay supplying the impulse that sends current to the magnet and to the lamps.

A Crude-Oil Motor without a Carburetor

ONE of our German correspondents sends a description of the motor-cycle outfit illustrated herewith, jumping right into the heart of his subject with the confident pronouncement that "Herr Joseph Loewy has after 15 years' work solved the problem of a crude-oil engine for the motor cycle", and lending a human touch by informing us that, when the inventor first led his production forth in public, "the crowd was extraordinarily large, in spite of the very cold weather" When the contributor gets down to actual description of the apparatus, we learn that it carries no separate carburetor, but that the mixing of the gas takes place in the cylinder jacket, where we are accustomed to look for the cooling water Only the upper part of the cylinder is ribbed (apparently for air-cooling), the lower half being surrounded and cooled by the inflowing fuel By this means the heavy crude oil, ordinarily difficult to thin or to ignite, is so strongly heated that when sprayed through a nozzle it enters the cylinder without any eddying The motor works on a two-stroke cycle, and develops about one and one-half horsepower It is started on benzol, and run so for the first two minutes until it gets warmed up. In this connection great importance is attached to a two-duty adjustable nozzle of extreme simplicity, which enables the switch of fuel to be made with no trouble at all. The account closes with a personal touch, Herr Loewy is a "self-made man," this English phrase apparently having been adopted by the Germans. Also, he is apparently not looking for capital to develop the machine, since our correspondent's final sentence pictures the inventor as "unable to save himself" from the importunate capitalists who are anxious to share in his prospective profits.

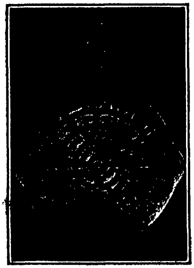
Recently exhibited German motor-cycle engine, running on crude oil and dispensing with a carburetor

Motor Cushion a Coiled Spring

THIS motor cushion for the convenience of motor car drivers is made of an 80-foot coiled spring wound spirally It gives a good cushioning effect and at the same time maintains an air space to permit heat from the body to escape The coil is closely covered with a woven textile allowing the circulation of air beneath and behind the back of the driver It is said to be an unusually cool cushion

Transformer Oils

THESE oils tend to form sludges, either slowly or quickly, according to the nature of the oil L. H Hill describes (*Electrical World*, New York) several tests that may be applied to the oil to determine its tar-forming properties, and gives references to original papers, where the description is more complete It is certain that the sludge-formation is a form of oxidation. One company has therefore introduced a type of transformer in which the oil is covered with a layer of inert gas, usually nitrogen A cyclical process, dependent on temperature and pressure, takes place, by which the nitrogen is driven out or sucked into the transformer Any incoming air passes through an automatic valve, and is then deprived of oxygen and moisture, it therefore becomes dry nitrogen. Thus the oil, being in contact with nitrogen, does not oxidize, the layer of nitrogen also minimizes any explosive phenomena.



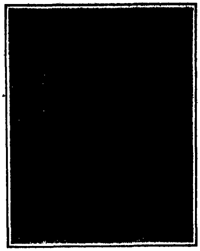
The grease goes into the channels of this waffled frying pan, rather than into the food

The Greaseless Frying Pan

FRYING is an operation that requires grease, but the victim of the frying pan knows all too well that he gets too much of this grease in the finished food. How can bacon, pork chops, sausage, lamb chops, eggs, etc., be fried in grease and brought to the table free from grease? The inventor of the waffled frying-pan herewith illustrated has sought to answer this question, and he says he has used the pan in his own household for a year with very good results. The fat expelled by the frying delicacy flows into the channels and stays there, where the food gets all the benefit of its presence without becoming steeped in it Mr M C Hughes of Allston, Mass., is the inventor

The Foot-Lock Vise

EVERY vise user has experienced difficulty in holding the work. If it is possible to screw the jaws down hard on the piece in the first place, after working with it for a while it will be found to be loose again. A very efficient vise lock is illustrated, which works with the use of the operator's foot. It is not an attachment for any vise, but must be actually built in. A kick upon the pedal locks the work behind a pressure of several hundred pounds, and a kick releases it with certainty and despatch The long lever attached to the pedal is the secret, the compounded purchase which this gives enables the jaws to be jammed tight against the work, no matter what the shape of the latter The screw is used, as in the standard vise, to bring the jaws into approximate engagement with the work after which the foot-lock is called in to clinch the matter



The vice that uses foot-power and compound leverage to jam its jaws tightly upon the work

Fire Tests of Roofing Materials

THE Bureau of Standards has prepared a program of tests, equipment is being procured, and test specimens constructed for conducting a series of fire tests of roofing materials with particular reference to the relative merits of wood shingles and prepared roofing.

A conference has been held with representatives of the wood shingle manufacturers, the prepared roofing manufacturers and the fire underwriters, at which agreement was reached on the methods of testing and on an outline of the program of tests.

Diffusion of Nitrogen Through Various Liquids

ONE of the difficulties which the Bureau of Standards has encountered in liquefaction of hydrogen is the securing of hydrogen of sufficient purity If other gases are present, they become frozen at a temperature higher than that at which hydrogen liquefies. This clogs up the apparatus and stops the process. The storing of hydrogen in any kind of a gas holder is, therefore, a matter of some difficulty because gases are very apt to diffuse through the liquid seal used in the holder and become mixed with the hydrogen.

Experiments were made during the past month on the relative rates of diffusion of nitrogen through glycerine, machine oil and water It was found that the rate of diffusion through glycerine is very much lower than through water or machine oil. This was to be expected because of the extremely low solubilities of nitrogen and other gases in glycerine The Bureau now proposes to employ glycerine as a seal for the gas holder used for the temporary storage of pure hydrogen.

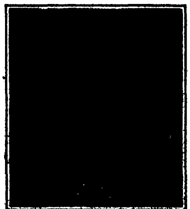
Colorless Waterproofing Materials for Stone

INVESTIGATIONS are now under way at the Bureau of Standards covering the action of frost on building stone and on the value of colorless waterproofing materials with which to protect the surface of stone structures. During the last month the series of exposure tests on colorless waterproofing materials, having for its object the determination of the relative durability of these treatments under weather conditions, has been supplemented by a series of tests to determine the efficiency of the different waterproofing materials in preventing decay of the stone

Crystallization tests are being made on waterproofed specimens to secure a comparison between treated and untreated specimens. Waterproofed specimens have also been exposed to the weather and will be tested after a considerable period of exposure.

Painting with a Wheelbarrow

CALIFORNIA'S highway commission is now painting a white line down the center of the highway south of San Francisco as a safety precaution to motorists. A very simple and efficient device is used for this purpose. It consists of a paint receptacle carried on a three wheel hand truck, with a hose leading from the receptacle to a paint brush attached to the front of the device just back of the front wheel This brush applies the paint to the surface of the highway, and a second brush attached a few inches back of the front brush spreads the paint to the proper width A red line is chalked on the pavement ahead of the paint spreader to guide the operator of the device.



Three-wheeled hand-truck used in painting the traffic line down the center of California roads

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Long-Distance Truck with Bunks

LONG-DISTANCE trucking is always more or less complicated by the necessity for eating and sleeping on the part of the crew In the endeavor to meet this, one manufacturer has put out the truck illustrated, with two bunks in the front seat. It is not the idea that one driver shall occupy the lower bunk while the other drives from the upper one—this is obviously prevented by the height of the latter But this arrangement makes it possible for the two-man crew to live entirely in the truck until they reach their destination, and thus to eliminate much of the delay incidental to the nightly stop. Attention is also called to the comfortable inclosed cab which permits all-weather driving

By living in this truck, the driver and his helper cover long distances with a minimum of delay

Rolling Palace Has the Comforts of Home

IF you have a hobby for highly personalized transportation and can write a check running well into five figures you can now gratify every desire for traveling luxury, distinction and novelty. Thanks to the utility value of the modern motor bus, an outlet has been given to the passion for a house on wheels or "sleeping coach" combining every modern convenience with the composite comforts of home, hotel and Pullman Such is the motor palace recently acquired by W K. Kellogg, breakfast food magnate and world traveler Fond of travel, Mr Kellogg has toured India, Japan and China and through virtually all European countries. He has made several trips to South America, has been in Alaska twice, in Hawaii and Egypt and now with his club car creation plans on renewing his acquaintance with America's wonders in a more leisurely and intimate way

With the automotive home there is no further need to "check your baggage and come back later" for a room and bath. Now you just drive and drive and stop where you please. In the wildest wilderness if you like, without the slightest inconvenience — comfortable sleeping berths, shower baths, ample cooking facilities, cracked ice made as you ride, market news and entertainment by radio The club car has all these conveniences and more Innocent looking panels of mahogany here and there conceal scores of unlooked for appointments.

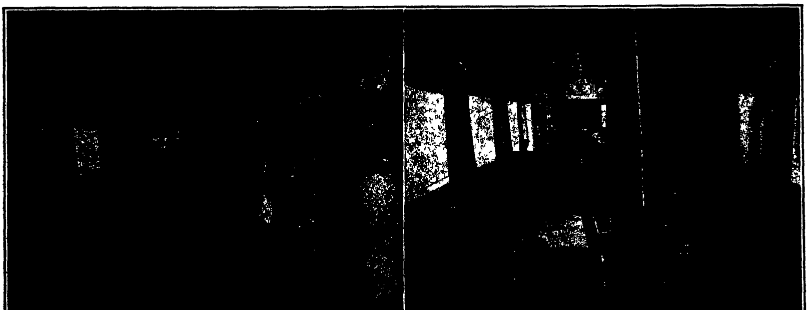
The motor palace is finished in mahogany and the finest of leathers throughout Entrance and exit may be made through five doors, three on the right side and two on the left. The driver's compartment is separated by a sliding glass partition The forward part of the car is equipped with four revolving chairs with adjustable backs, head rests and arms which can be quickly converted into full-sized berths for two The chairs are upholstered in taupe mohair plush with nickel fittings. Heavy adjustable curtains separate the sleeping quarters from the rear compartment as well as the berths The forward section may readily be transformed into a cozy dining room by the introduction of a folding table which, when not in use, is concealed in a panel at the side of the car Ample light is provided by dome lamps and separate reading lamps at each chair A dictograph permits communication with the driver without opening windows. The coach is designed for use in winter as well as summer and passengers need not be concerned by weather conditions. Rotating fans keep the car cool in warm weather while heaters set flush with the floor and connected to the exhaust pipe of the engine keep the car warm on the coldest day

Further inspection of the rolling home discloses wardrobe and linen closets, oil and electric stoves, sink, faucets for hot and cold water, an ice making plant, iceless refrigerator a china closet, a nickel hand basin, enclosed chemical toilet, French mirrors and dust-proof screens of fine nickel mesh Several electrical connections are conveniently located for curling irons, etc All kitchen utilities and other appointments are concealed when not in use by mahogany cabinets and closets so that the general effect is of pleasing cabinet work and upholstery

The water supply system for the entire coach is provided by a 40-gallon tank, pressure being maintained at all times by means of a pump driven by a power take-off on the transmission An electric power plant in the rear section furnishes current for the lamps, stoves and fans. Installed outside of the car is an iron folding frame which can be used to carry light baggage and when extended forms a large bed frame, which with mattress and rain cover offers additional sleeping accommodation It is possible a few conveniences a completely appointed home should have, have not been enumerated If so the mansion of ever-changing location has them

Motors Are Helping the Rural Schools

EIGHTEEN THOUSAND rural schools are furnishing transportation for pupils to and from their homes. Through the motor bus the consolidated rural school is made possible and the number of consolidations is going forward at the rate of 1,000 per year There are still 180 000 one-room schools which should be consolidated Since a consolidated school combines several adjacent school districts into one school it means a larger and better equipped school-house, since in the one-room rural school one teacher teaches all grades from the kindergarten to the eighth grade, while in the consolidated school each teacher instructs but two or three grades. This means fewer and more highly qualified teachers and better teaching



Two views of a luxurious motor home which contains every comfort found in the well-equipped American household

The Heavens in November, 1923

Figures Recently Arrived at Regarding the Great Nebulae

By Professor Henry Norris Russell, Ph. D.

THERE is no chapter of present-day astronomy in which more rapid or remarkable progress is being made than in the study of the nebulæ. A few years ago we knew little about them, except that they were hazy masses of light, far away among the stars, and that the luminous material was gaseous in some cases, and not so in others. Now we think of them as grouped in three definite, though not quite mutually exclusive, classes.

First in order we may mention the vast dark nebulæ, which we detect only because they hide the parts of the Milky Way that lie behind them. We owe our knowledge of these mainly to the lamented Barnard, who, single-handed and at first amid general incredulity, maintained and proved their existence. Some of them are so enormous that they appear as dark patches in the Galaxy, easily visible to the naked eye, others are small and sharply outlined. It is fairly certain that they are actual clouds of matter, and that the fine dust in them produces most of the opacity by which we detect their presence. The nearer ones are at moderate distances—a few hundred light years; yet even so, they must be dozens of light years long. These great clouds seem almost like residual fragments of the primeval chaos. There is no reason why we need suppose that they have ever been other than they are.

Next come the luminous nebulæ in the galactic region, including both the diffused and chaotic masses like the Great Nebula in Orion, and the rounded forms called "planetary nebulæ." The beautiful work of Hubble has shown that these nebulæ are always associated with stars, and doubtless derive their light from the stars. In some cases the luminous region is clearly only that part of a greater dark nebula which lies near the star and reflects its light. In others the luminous material consists of gas, which is set shining by the radiation of the star. Just how this happens we do not yet understand, but it is very significant that the stars associated with gaseous nebulæ are always of the very hottest types—most of all, those which form the nuclei of the planetary nebulæ.

The Spiral Nebulæ

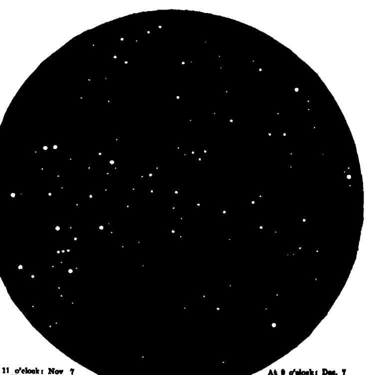
But the most remarkable problem of all is set before us by those nebulæ which lie far outside the Milky Way, and form by far the majority. Hardly any of these show a gaseous spectrum, and very few are chaotic in form. Thousands of them are round or oval, brightening up gradually toward the middle. A smaller, though still great, number show spiral arms extending outwards from a central mass—evidently in one plane, for we have many cases in which they are seen edgewise. All stages of transition appear to exist, from a round structureless mass, through more and more oval forms, to cases in which the spiral arms seem just to have budded out, those in which they are well developed, and others in which little of the central mass is left, while the arms have broken up into innumerable spots of light.

Does this obvious sequence give us a clue to the evolution of these strange objects, or are we merely reading into nature the phantasies of our own imaginations, so far-reaching a question cannot yet be answered fully, but there are many reasons to believe that the sequence has a meaning.

In the first place, these nebulæ are in rotation. For the brighter and inner portions, we know this with certainty from the spectroscopic work of several observers, following the brilliant initial work of Slipher. The motion is in the direction which would carry particles at the rim of the nucleus outward into the spiral arms, and its rate may rise to a hundred miles per second, or even more.

Farther out, where the nebula becomes so faint that its spectrum cannot be photographed with any reasonable exposure, it is fortunately still possible to find the motions of the individual nebulous condensations, by comparing photographs taken at intervals of ten or a dozen years. Van Maanen, at Mount Wilson, has been the protagonist in this difficult field. Seven different spirals, which he has measured, all show motion of the nebular points around the nucleus and, though to a less degree, outward, so that they appear to be streaming away from it along the arms. The motions look slow (a few seconds of arc, at most, per century), but correspond to a complete rotation in from 50,000 to 200,000 years.

This is a surprisingly short period, for the nebulæ are presumably very old, and yet the observed motions would carry their outer portions clear away, into the regions where we now see nothing, in a single million of years. Evidently stuff is coming out of the nucleus and escaping into space—shining at first, then becoming dark. When one of these giant spirals is turned edgewise toward us, this outer region can be seen as a dark, opaque band, crossing the brighter portions.



At 11 o'clock: Nov. 7
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9½ o'clock: November 30.

At 9 o'clock: Dec. 7
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 22.

NIGHT SKY: NOVEMBER AND DECEMBER

Distances and Velocities

In the last nebula which he has studied—known as Messier 33, from its number in the catalog of nebulæ prepared by that astronomer a century ago—van Maanen has measured four hundred of the almost countless specks of light in its outer portions. One of these showed a relatively rapid motion, and must be a faint star, far nearer us than the nebula, all the others fell in line with the majestic circulation, like a vast whirlpool, spreading outwards. The labor of measuring, with all possible precision, so many objects—not to mention the faint stars used as points of reference—must have been enormous. In fact, the writer may be pardoned in quoting Dr. van Maanen's remark, after talking of the work, "Some time, after forty years or so, somebody ought to get new photographs, and measure a thousand points on this nebula. Before that time I hope to die!"

But the results richly justify the labor. Not only do they give the most complete knowledge of nebular motions which we have yet attained, but they make possible, for the first time, a direct estimate of the distance of the object. One condensation, in the outer part of the nebula, is bright enough to permit a spectroscopic determination of its radial velocity; and it shows a great difference from the velocity of the central mass. If we can safely pass from this motion in the line of sight to motion in the plane of the nebula itself, we may by comparison with the photographs work out the distance. To do this, we need only know at what angle the plane of the spiral arms is inclined to our line of sight. This is rather hard to find, but as the shorter diameter of the nebula appears to be about 80 per cent of the longer, the inclination may be estimated as from 35 degrees to 40 degrees. The parallax then comes out 0.0005 second, the distance about 6,000 light-years, and the rate of motion in the outer mass about 150 miles per second. The nebula is about half a degree in diameter, which, at this distance, corresponds to some 60 light-years.

This appears to be the most trustworthy estimate of the distance and size of a spiral nebula which has yet been made. Other methods, less direct but applicable to more nebulae, indicate distances of the same order of magnitude. We may well, for the present, think of the larger spiral nebulae as lying at distances of several thousand light-years, and as being themselves a few thousand light-years in diameter. This is certainly big, but small indeed in comparison with the size of the Milky Way, which is measured in hundreds of thousands of light-years.

It would be tempting to go on to estimate the mass of Messier 33, and if the motion of the outer parts was orbital it would be easy. The period of rotation, at 10 minutes of arc from the nucleus, comes out from van Maanen's figures at 170,000 years. The actual distance from the nucleus should be about 1,200,000 times that between the earth and the sun. To keep a planet moving with this period at this distance, the mass of the nucleus would have to be 60,000,000 times that of the sun!

But fortunately, the motions of the various nebular particles do not follow the ordinary law of orbital motion under gravitation. The orbital velocity, instead of growing smaller at greater distances from the center, gradually increases, while the outward motion diminishes. This is extremely puzzling. The drop in the outward motion might be explained by the attraction of the nucleus, but the increase of the lateral motion, at right angles to the radius, demands the action of a force which is neither attraction nor repulsion, but acts sideways. No one has any idea what such a force can be, and it may take much work before the right clue is found. The most obvious suggestion is that the luminous points in the outer part of the nebula are not flying freely in empty space, but are immersed in a great moving sheet of dark matter, which drags them along with it, but this, too, presents great difficulties.

We need not mourn, however, because there are still worlds to conquer. It is ground enough for satisfaction that we have so good an idea of the size and distance of this wonderful object. Even our rough estimate of its mass may be of some value. If there were not enough stuff in the nebula to make millions of suns, it is hard to see why the fast-growing condensations do not fly off in straight lines, instead of in their obviously curved paths.

The Heavens

By this season the winter constellations are returning to our view. Orion is high in the southeast with Taurus above and Sirius blazing below. Gemini and Canis Minor are to the left, with Auriga higher and farther on. Perseus is high in the northeast and Cassiopeia and Cepheus in the north, while the Dragon and the Bears are below the pole. Cygnus is well down in the northwest, with Lyra and Aquila setting below. The southwestern sky is dull, the great square of Pegasus being the only prominent configuration within it.

The Planets

Mercury is in conjunction with the [illegible] on the 19th.

(Continued on page [illegible])

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—L. Jacoby, Paris, Ky This invention relates to controlling means for airplanes and has for its general object to provide means which may be embodied in the structure of an airplane and which will permit an exceedingly flexible control. It is also an object to provide means whereby the normal descent or ascent of the plane may be accelerated, and means whereby to facilitate the control of the airplane when in flight.

AERIAL PROPELLING MACHINE.—S. V Cortes, c/o Chilean Naval Com., 56 Victoria St., Westminster, London, S W 1, England. The main object of this invention is to provide a permeable casing with deflecting vanes for enclosing a rotary propelling mechanism, and which can be adjusted by means of suitable mechanism, in order to obtain an efficient utilisation of the forces developed by the rotation of the propelling mechanism in the required direction

Pertaining to Apparel

GARMENT POCKET.—G W Walker, 2207 Seminary Ave., Oakland, Calif. The invention relates more particularly to a pocket which is best suited according to its peculiarities to workmen's garments, such for instance, as overalls, carpenters' aprons, coats and the like. Among the objects is to produce a pocket which will conveniently accommodate a quantity of nails or other articles, and remove the likelihood of the dropping out regardless of any tilted position.

GARMENT.—I. Rogoen, 5 Beekman St., New York, N. Y One of the primary objects of the invention is to provide a placket especially adapted for shirt sleeves. A further object is to provide a placket in which the material employed in the manufacture thereof may be reduced, thus making it possible to use scraps rather than good material and thereby reducing to a minimum the waste in good material.

GARMENT SUPPORTER.—J S. Wallingford, 305 1st Nat'l Bank Bldg., Paris, Ky The invention relates to a clasp element for use in connection with hose supporters which reduces to a minimum the tearing or destruction of the garment by distributing the supporting strain over a wider area of the garment. Further the invention aims to produce a clasp which, when properly associated, insures the retention of the garment against accidental displacement, while at the same time permitting of ready release and application.

Electrical Devices

TERMINAL FOR DRY BATTERIES.—H M Koretzky, c/o Bright Star Battery Co., 310 Hudson St., New York, N Y The invention aims to present a type of battery which may be so constructed as to preclude the danger of any loss of the terminal clamps, the terminal further embodying the feature of adaptability to the carbon electrode so that no danger of a loosening of the former from the latter, and a resulting bad contact is to be feared

2.—WHAT IS A PATENT?

A PATENT is a purely statutory creation, and there is no common law right of property in an invention. In its inception the patent right was a monopoly granted by the Crown. During the reign of James I the English Parliament established the beginnings of patent rights as we know them in present times, by taking from the Crown the right to exercise this power of granting patents, except in the case of inventions. The patent today is property, it is a franchise; it is a contract with the Government, by virtue of which the inventor, in consideration of his giving the public knowledge of his discovery, receives in return a monopoly thereof for a limited period, at the expiration of which the discovery becomes public property, and, in so far as that patent is concerned, may be freely made, used, sold or practiced by all. As patent rights are property, the owner thereof is entitled to the same protection therein, both legally and equitably, as in the case of any other property, and he may likewise by assignment, divest himself of his property as he may see fit. A patent, contrary to a general acceptance of the idea, does not grant the right to make or use the subject-matter thereof, it merely grants the right to exclude others from so doing, if the owner of the patent so desires. But the mere grant of a patent, even an entirely valid patent, does not preclude that the subject thereof infringes an equally valid but earlier and broader patent. Thus, the patentee may find himself the owner of a patent, and yet he may not be able to use the subject-matter of that patent without infringing the corresponding patent rights of another patentee. On the other hand, no one may, without the consent of the later patentee, make use of the patented subject-matter of that later patent.

TELEPHONE SUPPORT.—J J Moss, 3406 Lexington St., Chicago, Ill An object of the invention is to provide a telephone support which may be readily secured to a wall or the like, and which has means for readily and instantly adjusting the telephone to the desired height. A further object is to provide a device which has means for supporting the receiver when the latter is not disposed on the telephone hook.

CHANGEABLE COLOR SPOTLIGHT—J M. Dollison and C. E. Smith, Address C. E. Smith, 30 Ruggery Bldg., Columbus, Ohio. An object of the invention is to provide an apparatus for projecting rays from an electric bulb through a colored screen in order to provide illumination for exhibiting window displays. A further object is to provide a rotating color disk having translucent portions of different colors for creating the effect of continuous blending of color

ELECTROLYZING APPARATUS FOR THE MANUFACTURE OF OXYGEN AND HYDROGEN.—G F Jaubert, 155 Boulevard Malesherbes, Paris, France The invention relates to apparatus to be used for the manufacture of oxygen and hydrogen, it comprises a tank containing an electrolyte, nickel electrodes having tubular stems of the same material, a frame supported in the tank and supporting the electrodes and foraminous diaphragms of fine mesh and mounted in the frame and separating the electrodes.

Of Interest to Farmers

ATTACHMENT FOR TRACTORS—H M. Greasley, Corry, Pa. The invention particularly relates to an attachment adapted to operate for preventing a wheeled tractor from turning backwards, upon the rear drive wheels being held in a roadway or field, against rotation. An object is to utilise the movement of the tractor body or frame, when said tractor is turning backwards, for operating mechanism adapted to stop the power to the driving shaft, the mechanism is simple and adapted to be applied to any type of wheeled tractor

MANURE LOADER.—F E. Null, 1100 W Springfield St., Urbana, Ill. The invention has for its object to provide a machine which is effective to completely gather or pick up the material from the ground, elevate it without loss or scattering and transfer it to a lateral conveyor movable in either direction and controlled by an operator The device is in general simple and durable, comparatively easy to operate, and inexpensive to manufacture.

TRACTOR HITCH—M. M Knowles and J N Bates, Fort Branch, Ind. The general object of this invention is to provide a brace that will cause a side draft hitch to function as if the hitch were central with the line of draft and which will be free to automatically adjust itself to a complete turning movement of the tractor and yet be adapted to be made rigid as is desirable when operating over rough ground

FENCEPOST ATTACHMENT—P T Bailey, Box 272 R. R. 2, Newport, R. I Among the objects of the invention is to provide an attachment at the top of the fencepost for retaining a pipe or bar in position, and which in addition presents means for carrying fencing wire and thereby permits the use of a comparatively short post and at the same time presents an ornamental appearance

GRAIN SHOCKER FOR HARVESTER BINDERS.—J E. Dery, Edgeley, N D The purpose of the invention is the provision of an attachment to be applied to various makes of harvester binders whereby the bundles of grain delivered from the binder are formed into shocks and deposited upon the ground in an upright position A further object is the construction of a shocker that may be readily adapted to harvester binders without requiring changes.

Of General Interest

LIFE BOAT APPARATUS—F A. Graham, Harbor Springs, Mich. The invention has reference more particularly to an apparatus which is manually operated and does not require fuel, and which is adapted to actuate the propeller by compressed air, the heat from compressing said air being utilised in distilling salt water for drinking purposes. An object is to provide an apparatus which may be operated by the occupants of the boat for providing distilled water, and compressed air as power to operate the propeller

COUPLING—J Zajic, 520 E. 81st St., New York, N Y The invention relates to a coupling particularly intended for connecting the ends of a cord or rope, or for attaching a snell to a fish line. The general object is to provide a coupling of very simple form with a view to promoting convenience in applying the coupling to effect a secure connection between the coupled elements. (See Fig 1)

WINDOW DOG KENNEL.—C Chaplin, 258 Madison Ave, New York, N Y. An object of the invention is to provide a dog kennel adapted to be mounted on the outside of a window sill of an apartment house or other dwelling, and connected to the window frame in such manner as to be properly supported and protected from rain, the arrangement being such that access may be secured thereto at any time from the interior of the building. (See Fig 2.)

COMBINED RULER AND BLOTTER.—A Azcona, Magdalena, Mexico One of the principal objects is to provide a device which facilitates the ruling of lines with pen and ink without soiling or blotting the paper, and the blotting of the lines or writing by rolling the blotter over the same thus preventing smearing and further eliminating loss of time in picking up a separate blotter The device consists of a plurality of sections, the outermost being adapted to be removed and discarded when unfit for use. (See Fig 3.)

COMBINED PAIL AND STAND—A. G Harrington, 415 Ann St., Birmingham, Mich. In paper hanging or many other forms of labor where a pail is used it is necessary for the worker to frequently stoop for dipping the brush or the like. The object of the invention is to provide a combined pail and stand whereby the pail may be quickly elevated and so held wherever the user may wish, and thus eliminate the tiresome stooping (See Fig 4.)

FOOT REST—F P Litz, address D F Smith, attorney Corry, Pa. The object of the invention is to provide a foot rest for use with bootblack stands or the like, which is adjustable and removable whereby when the foot rest is not in use it may be removed or adjusted so that it will not afford an obstruction liable to catch and tear the clothes of a person using the rest, or impede the movement of a person in stepping upon or leaving the stand.

VANITY CASE—W G Kendall, 118 Market St, Newark, N J The inventor

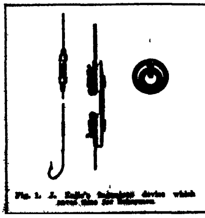


Fig. 1. J. Zajic's ingenious device which saves time for fishermen

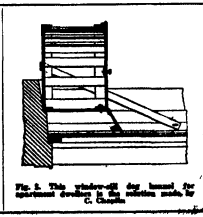


Fig. 2. This window-sill dog kennel for apartment dwellers is the solution made by C. Chaplin

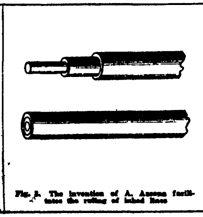


Fig. 3. The invention of A. Azcona facilitates the ruling of inked lines

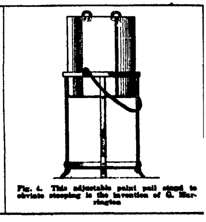


Fig. 4. This adjustable paint pail stand to obviate stooping is the invention of G. Harrington

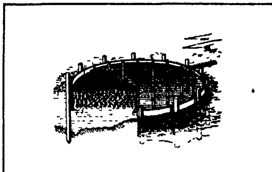


Fig 5 To prevent evaporation, this tank, invented by A. S. Cooper, is submerged in water

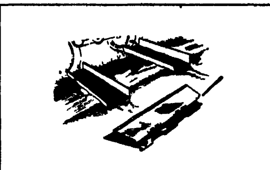


Fig 6. Motorists will appreciate this simple portable roadside bridge, the idea of R. D. Gallager

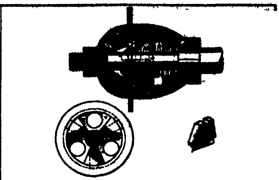


Fig. 7. To clamp and center circular saws, etc., this device was designed by G. L. Norris

has been granted two patents of a similar nature relating to vanity cases adapted to contain a carrier filled with compact powder, and provides a form of retaining means on opposite sides of the central partition of the carrier so constructed that it will in no way interfere with the powder packing or pressing operation The retainers may be removed from the case for the purpose of renewing the cosmetics when the same become exhausted A further object is to provide a device which will be simple, neat and attractive in appearance.

SPIRAL ROPE AND CABLE GRIP.—G J ZINK, 2313 Folsome St., San Francisco, Calif The invention relates to means for securing a cable or rope around an object, as, for instance, a log of wood to be moved, or on the front axle of an automobile to be towed. A particular object is to provide means for temporarily securing a cable which can be fastened and unfastened without any effort and still positively secure the cable to the object so firmly that it cannot lose its grip, no matter how much towing power is applied.

GATE VALVE.—J E. DEMPSEY, c/o Acme Cement & Plaster Co, Olive and 9th Sts., Acme, Okla. Among the objects of the invention is to provide a gate valve especially adapted for application to grain bins and the kettles of plaster mills, although the valve is capable of a variety of applications and may be applied to a cylindrical container and the attaching face of the casing may be concaved and the discharge spout either straight or inclined.

CLASP—L. JASNER, P O Box 1665, Station C, Los Angeles, Calif. Broadly speaking, this invention contemplates a clasp for jewelry including a pair of members, one of which is adapted to receive the other and within which former member means is arranged for coacting engagement with the other member to lock and retain the members together against separation, with exteriorly exposed means for releasing the locking means.

CLOSURE FOR CONTAINERS.—D BLOOM, 1538 Edith St., Berkeley, Calif. The primary object of the invention is to provide a closure which will positively seal jelly and preserve glasses and tumblers, and which may be produced at a modest cost. A further object of the invention resides in the simple manner in which it is applied, which enables the closure to be used by housewives as well as packers operating on a large scale.

SCREENED DRAIN—T C. KUNKEL, Madrid, Neb. An object of this invention is to provide a screened drain which is adapted to be used on a window or door screen and which may be easily attached to the ordinary window screen without the use of nails or screws. A further object is to prevent the window screen and window sill from decaying by permitting the water to drain, at the same time preventing insects or the like from entering.

FIRE EXTINGUISHER.—P BRAUDE, 229 Madison Ave, New York, N Y The principal object of the invention is to provide a simple and inexpensive package which is indestructible by fire whereby the same could be used as a bomb to be thrown directly into the flames to extinguish the same A further aim is to provide a frangible closure readily broken by the finger to permit the emptying of the contents onto the flame.

MATCH CASE.—S SPRAGUE, Box 481, Times Plaza, New York, N Y Among the objects of this invention is to provide a case or container for dispensing the contents thereof and delivering the matches singly, whereby the case may be employed as a holder for the lighted match to preclude the possibility of burning the fingers, means being provided for ejecting the used match, the device may be used in connection with common form, or safety matches.

WINDOW—S. U BARR, c/o W H. Jackson Co, 335 Carroll St., Brooklyn, N Y This invention has for its object to provide a window arranged to permit of easily and conveniently moving the sashes up and down and to render the window air and water tight at the time the sashes are in closed and locked position, and without the use of packing strips or the like.

LOCKING DEVICE FOR FRUIT CANS OR THE LIKE.—H H ORDUNG, 114 H St., Laporte, Ind An object is to provide a locking device which is adapted to closely engage with the walls and top of the can whereby it will not interfere with the packing of the can. A further object is to provide a device which may be readily attached to cans of ordinary construction without altering their construction The device consists of few parts, and is not likely to get out of order

FACING FOR CEMENT WALLS.—F A NORTHWALL, 4th and Wood Sts., Portland, Oregon. This invention has for its object to provide a facing for walls whereby the exterior of the cement wall of a house or the like may be given a neat and artistic appearance. It is also an important object that the facing may be adapted to be locked in position at the time of building or pouring the cement.

DIVISION PLATE FOR EGG CASES.—J C. VOORHORST, 436 Star Bldg, Washington, D C The invention aims to provide a dense packing division plate capable of safely transporting eggs, bottles, fruits and the like, which will answer all requirements in the nature of conditions precedent to its use in storage, ocean transport and through the mails. A further object is the provision of a plate which will be yieldable to permit of expansion or contraction, and for properly fitting egg-case compartments of non-standard dimensions.

MOUNTING FOR STYLUS LEVERS.—G W SLIGHT, P O Box 220, Framingham, Mass. The general object is the provision of a simple mounting for stylus levers in sound boxes, provided with a self-compensating means for taking care of the wear in the bearings. These objects are accomplished by the provision of a lever having a trunnion extending at right angles thereto, forming bearings in the casing, one of which is a groove extending at an angle to the axis of the trunnion, and mounting on the casing a spring which tends to draw the trunnion along the groove to compensate for wear

TANK.—A. S. COOPER, 610 So. Broadway, Los Angeles, Calif. The invention relates to tanks for the storage of oil or other liquids which are lighter than water An object is to provide a bottomless tank of this character partly submerged in a body of water so that it will be in convenient position for storage of fuel oil, with small loss by evaporation. The device may be easily erected and transported to different localities, the walls being of light construction, either of metal strips that may be rolled horizontally, of wooden slats with metal bands. (See Fig. 5.)

PORTABLE BRIDGE.—R. D. GALLAGER, Bay St. Louis, Miss. Briefly stated, an important object of the invention is to provide a portable bridge, adapted for emergency use, which may be conveniently attached to the upper or lower side of the running board of a vehicle, and readily set up for use when necessary A further object is to provide collapsible sides which, when swung to an upright position, will brace the tread portion of the bridge. (See Fig. 6.)

Hardware and Tools

CENTERING AND CLAMPING MEANS FOR SAWS AND OTHER ARTICLES.—G L. NORRIS, 224 W 2nd St., Wilmington, Del. The invention relates to arbors for saws, emery wheels or the like, and particularly to means for centering the saw on the arbor and clamping the same in position. The general object is to provide a centering and clamping means whereby to promote simplicity of assemblage, secure fastening, and to provide for the facility with which the saw or like may be clamped or released. (See Fig. 7)

PIPE REPAIR CLAMP—J W BLAIR, 378 8th Ave., New York, N Y. Among the objects of this invention is to provide a pipe repairing clamp for use in connection with boiler and refrigerating plants where the device is to be applied to one of a nest of closely spaced pipes, by this device it will be possible to associate the body portion of the clamp with one of the nest of pipes irrespective of the proximity of the next adjacent pipe.

BRACKET—B. V CZARNECKI, 907 Campbell Ave., Schenectady, N Y. This invention relates to brackets especially adapted for supporting shade rollers and curtain rods. An important object is to provide a bracket which is neat in appearance, stamped from a single blank of metal and having means whereby the same may be secured to a window frame without employing nails or similar fastenings, which mar the appearance of the frame.

AUTOMATIC LOCK COCK.—J T. O'GORMAN, 1966 Morris Ave., Bronx, N Y. The invention particularly relates to a safety device for locking a gas cock or other form of valve adapted to be moved from an open to a closed position or the reverse. The object is to provide a lock which will automatically become locked when moved to a closed position, but will permit the valve to be adjusted and manipulated by the same hand which opens and closes the cock. (See Fig. 8.)

FISHING TOOL.—C. H. BROWN, Breckenridge, Texas. An important object of the invention is to provide a grapple or fishing tool, especially adapted for use in connection with oil and other wells, having means whereby the same may be engaged with the food valve of an oil well for the purpose of removing the valve, the grapple is so constructed that its movement upon being engaged with the valve is limited, whereby the spring arms are enabled to withstand the strain incident to use. (See Fig. 9)

ADJUSTABLE BRACE.—W. LEMOIGNE, Box 664, Colusa, Calif. This invention relates to braces used for imparting rotary motion to tools, such as drills, screwdrivers and others, the particular object being to provide a brace that may be used in the ordinary way but possesses special features of adaptability and can be used in almost any corner or under any conditions where the ordinary brace would be practically useless. It is a further object to produce the brace without materially increasing the cost of manufacture. (See Fig. 10.)

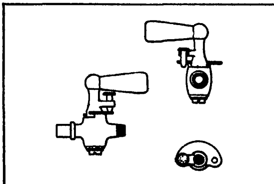


Fig. 8. For locking a gas cock in the desired position this is J. T O'Gorman's idea

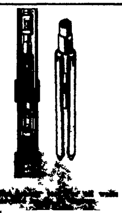


Fig. 9. [illegible] oil wells was [illegible]

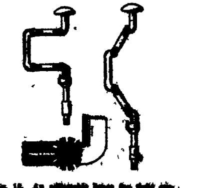


Fig. 10. An adjustable brace [illegible] the [illegible] of W. [illegible]

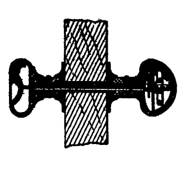


Fig. 11. Here is a simple, practical doorbell and button combined by J. A. Baginley with the knobs

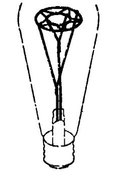


Fig. 12. Breaking of electric light filaments is less annoying, following the invention of this device by A. S. Volpian

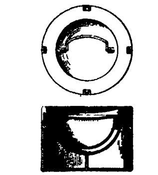


Fig. 13. Conservation of fuel is the idea behind this vacuum-receptacle heater designed by E. W. Owens

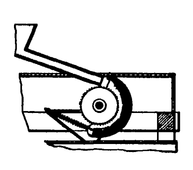


Fig. 14. In this machine H. Warren decorticates nuts

FURNACE GRATE.—H. BENTON, 657 Jefferson Ave., Elizabeth, N. J. The general object of the invention is to provide a construction whereby grids on grate bars present an increased area and the dead or fixed grate surface is practically eliminated, whereby also an increased air circulation is provided at the sides and center of the grate and an increased amplitude of movement in the shaking and dumping of the grate is provided for.

DOORBELL.—J. A. BAGINLEY, 2536 Pacific Ave., Hoquiam, Wash. The object of the invention is to provide means whereby a bell may be carried on the knobs of a door in such a manner that the bell may be easily operated from the exterior door knob. It is also an important object that the bell will in no way lessen the artistic appearance of the door knobs. (See Fig. 11.)

Heating and Lighting

LAMP FILAMENT AND SUPPORT.—A. S. VOLPIAN, 120 W Washington St., Greenville, S. C. An object of the invention is to provide a filament and separated supporting elements with which the filament has contact at various points so that should the filament break or current be otherwise interrupted at one point the remainder of the filament will be continued in circuit with the supporting elements and illumination maintained. A further object is to provide a support to prevent short-circuiting as well as provide strength. (See Fig. 12.)

GRATE CONSTRUCTION.—C. A. SHIVELY, 809 North "M" St., Tacoma, Wash. Among the objects of this invention is to provide a grate construction for boiler furnaces and the like, so formed and arranged that the bearing bars may expand or contract longitudinally or transversely or become distorted on account of the heat or weight without injuring the supporting walls of the device or rendering the same unserviceable.

COOKING UTENSIL.—H. J. DANIEL, Sutherlin, Va. The object of this invention is to provide a steamer especially adapted for use in canning or for cooking a number of foods simultaneously. An important object is to provide means whereby the rise of the water level of the outer receptacle due to increase in steam pressure may be utilized to relieve the steam pressure and thereby prevent the water in the outer receptacle from overflowing onto the stove.

OIL BURNING ATTACHMENT.—A. KAMMERMAN and A. ZAUGG, 12515 Woodward Ave., Highland Park, Mich. The invention relates to oil-burning means employing steam to atomize the oil or heavy hydrocarbon being burned and more particularly relates to an attachment designed to be employed in connection with the steam boiler of a heating system, a hot air furnace or the like. The general object is to provide an attachment arranged to promote convenience in installation, operation and repair.

VAPORIZER FOR LIQUID-FUEL BURNERS.—J. E. MALIVERT, 9 Rue du Telegraphe, Paris, France. The object of the invention is to provide a gasifying device for soldering lamps, soldering irons, chafing dishes and similar articles in which gasoline is used. The device is adapted to prevent the carbonization of the cotton wick by spacing the same from the burner and thus insuring the proper functioning of the wick at all times.

BOILER AND WATER HEATER.—J. CONYERS, 94 Cannon St., New York, N. Y. The invention pertains more particularly to a device for utilizing waste heat in the chimney of a boiler. One of the primary objects is to so construct the device that it may be attached to the chimney of a boiler in such manner as to utilize the waste heat for the purpose of heating water and provide an unobstructed circulation of water at all times.

OIL-BURNING APPARATUS.—W. E. FISHER, 717 W Main St., New Iberia, La. The invention relates to oil burners for use in connection with steam boilers, a purpose is to provide an oil burner by means of which the intensity of the flame emanating from the burner is automatically controlled in accordance with the variance in pressure of the steam in the boiler and in such manner that the relative proportions of oil and steam applied to the burner remain constant.

Machines and Mechanical Devices

TAPE FEED FOR MOISTENING MACHINE.—R. M. BROOKS, Root 2, Roseburg, Oregon. This invention relates to a device for handling adhesive tape. A special object is to provide means by which a portion of the tape may be separated from a roll by merely pressing on a foot pedal and in which the separated piece is moistened simultaneously so that it is ready for immediate use.

HOISTING MACHINE.—C. UHL, 301 Chickasaw Ave., Bartlesville, Okla. Among the objects is to provide a machine for hoisting the casing, tubing and rods from wells. The foremost object is to provide a combined hoisting machine and coupling, both being embodied in an automobile truck, and so arranged that when the coupling is joined in one way the truck will be operated as such, and when the coupling is shifted into connection with the hoisting apparatus the machine may be used for that purpose.

CORE AND CHUCK.—P. DE MATTIA and B. DE MATTIA, c/o Munn, Anderson & Munn, 233 Broadway, New York, N. Y. The invention relates to the manufacture of pneumatic tires. An object is to provide a core and chuck mounted upon a revoluble table forming part of a jack, and so connected that they may be quickly removed, and that the connecting device shall form an effective connection not liable to disarrangement while turning the core as the tire is formed thereon.

HOT-SLAG RECEPTACLE.—E. E. JAMES, c/o R. W. Owens, 25 W 84th St., New York, N. Y. This invention relates to a portable receptacle of the vacuum type for holding a quantity of hot slag, the device being so constructed that the receptacle may be filled at the smelters and transferred to a dwelling or other place where the slag could be used in a so-called fireless cooker, or for other heating purposes. (See Fig. 13.)

METHOD AND APPARATUS FOR DECORTICATING NUTS.—H. WARREN, 108 City National Bank Building, Galveston, Texas. The object of this invention is to provide a device for removing the fibrous husk of nuts by severing the husk structure with a cutting action along lines extending longitudinally of the nut, and simultaneously prying the severed portions radially of the nut and twisting them circumferentially with respect thereto. The nuts are fed to the husker singly, the husks completely removed and disassociated from the nuts. (See Fig. 14.)

TURBINE.—L. DE SANTIS, c/o Russo, 2419 Arthur Ave., Bronx, N. Y. Primarily the invention contemplates a turbine having independably actuated rotor units mounted on a common drive shaft and arranged in a common housing whereby the reverse driving of the drive shaft may be obtained and whereby when one of said units is actuated, the other inactive unit will constitute a balance or flywheel for the other. The turbine is constructed with a primary intake and a plurality of auxiliary intakes, and with manually controlled means for increasing or decreasing the pressure against the rotor. (See Fig. 15.)

PROPELLING ATTACHMENT FOR BOATS.—J. N. COUGHLAN, 209 W 115th St., New York. This invention has for its object to provide means whereby a person can, with a comparatively slight effort, very readily operate the boat by means of a propeller which is connected with a support readily applied to and removed from the boat structure. The support or frame contains all the necessary elements for propelling and steering the boat without requiring any alteration of the boat structure. (See Fig. 16.)

CLAPPER VALVE.—A. F. THORSTEN, 349 11th St., Brooklyn, N. Y. The invention relates to valves for outboard discharge of waste, and especially to scupper discharge pipes of ships. The aim is to produce a clapper valve which is so constructed that it remains closed at any angle from the horizontal to the vertical, irrespective of the rolling or plunging of a ship, yet requires a minimum amount of water to effect its opening. (See Fig. 17.)

ELEVATOR SYSTEM.—W. GROMER, 36 8th St., Woodside, L. I., N. Y. The principal object of the invention is to provide an elevator system involving the use of a plurality of cages and guides with supporting and controlling means therefor, whereby a cage is not limited to ascend or descend in a single shaft, but may be shifted at different levels from one shaft to another whereby a greater plurality of cages may be employed than the number of shafts, and a greater number of passengers transported in a given period of time. (See Fig. 18.)

POSITIVE LET-OFF MOTION FOR LOOMS.—J. A. PORTER, Shiley Mills, Macon, Ga. The general object of the invention is to provide a positive let-off for looms by the action of which the warp will be at all times under perfect control. An important object is to provide a positive let-off motion that will be independent of the beam so as not to be subject to the variation due to the varying diameter of the warp beam.

FILM CLEANING APPARATUS.—M. COHEN, c/o I. Pulver, 1015 Longwood Ave., Bronx, N. Y. The invention relates particularly to an apparatus for cleaning moving picture films. The object is to provide an apparatus which will clean both sides of the film without in any way injuring the same, the device gently washing the sensitized side and then polishing the unsensitized side.

APPARATUS FOR MANUFACTURING FLOWERS OF SULFUR.—E. KNAPP, J. K. DICKERSON and F. L. BEGTRUP, c/o G. F. Thompson, Niagara Sprayer Co., Middleport, N. Y. This invention pertains to a condensing chamber into which the vapors of sulfur are led and condensed to finely divided powdered sulfur, which is commonly known as "flowers of sulfur." Among the objects is to so construct the chamber that the liquid sulfur may be collected at a point where it is formed and separated and

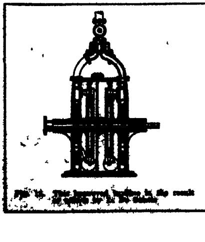


Fig. 15. This improved turbine is the result [illegible] by L. De Santis

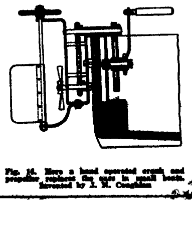


Fig. 16. Here a hand operated crank and propeller replaces the oars in small boats. Invented by J. N. Coughlan

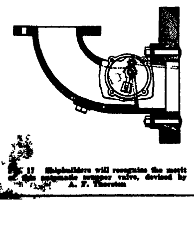


Fig. 17. Shipbuilders will recognize the merit of this automatic scupper valve, devised by A. F. Thorsten

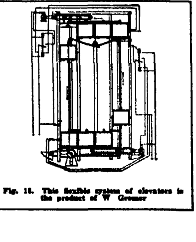


Fig. 18. This flexible system of elevators is the product of W. Gromer

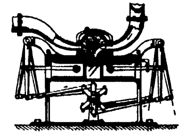


Fig. 19. Acting on the rotary valve and piston principle, this hydraulic motor is the invention of R. Rivera

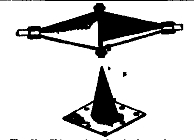


Fig. 20. This strainer for the internal combustion engine is the invention of De Forest Byers

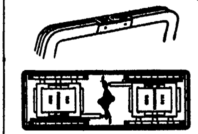


Fig. 21. By using this clever device of N J. Ryan's railways will prevent free riding of passengers

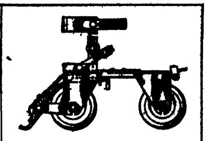


Fig. 22. W O. Carley's roller skate has a brake and two wheels only

maintained at all times separable from the flowers of sulfur formed within the chamber

SURFACING MACHINE.—W H Francis, Coffeyville, Vitrified Brick & Tile Co., Coffeyville, Kans. The aim of the invention is to provide a device to be used in conjunction with the manufacture of bricks, and for the purpose of making mat texture facing brick. A further object is to provide a machine by means of which mechanism is provided not alone serving to dig the surface but to also redeposit the dug material upon the face of the member

PACKING FOR PUMPS.—W A. O'Bannon, 519 E. 1st St., Tulsa, Okla. Among the objects of the invention is to provide a packing for use in connection with pumps of oil wells of the type in which the cylinder moves with relation to the plunger during the operation of the pump. A further object is to provide a packing adapted to be used between the plunger and traveling barrel and sealing the same in an efficient manner The packing is simple and may be applied to different types of pumps.

CLEANING APPARATUS — J M. Stepp, Williamson, W Va. The invention relates to a device adapted for use in cleaning such floor coverings as carpets and rugs. An object is to provide a device whereby a cleaning solution or pure water may be applied in the form of a spray to a floor covering and picked up by means of a suction head which also picks up the dirt encountered, and leaves the rug or carpet clean and dry

HYDRAULIC MOTOR. — R. Rivera, Sonsonate Salvador, C A. The object of the invention is to provide for a simple automatic action in hydraulic motors through the use of a readily adjustable, readily controlled valve mechanism, which may be thoroughly and effectively lubricated, and which is capable of ready and convenient repair or substitution of parts at all times. The parts are mostly in full view, therefore, any adjustments or repairs, if necessary, are a simple matter (See Fig. 19)

Prime Movers and Their Accessories

STRAINER. — De Forest Byers, Box 185, Clear Lake, Iowa. This invention relates generally to gasoline straining attachments for internal combustion engines of various characters and in various uses, and more particularly to a strainer which may be readily interposed within the gas supply line, for instance, between the supply tank and the carbureter to prevent the passage of sediment along with the fuel into the carburetor This device when installed needs attention only at long intervals. (See Fig 20.)

FLEXIBLE COUPLINGS —E. Schwarz, c/o Magneto Attachment Co., 3008 Park Ave., New York, N Y The invention pertains more particularly to shaft couplings of the flexible type. The primary object is to provide a coupling for magnetos, generators and other accessories used in connection with internal combustion motor power plants. It is a further object to construct a coupling by means of which the armature shaft of the magneto is adjustable relatively to the driving shaft to permit of a proper timing of the magneto.

Railways and Their Accessories

INDICATOR FOR CAR SEATS.—N J Ryan, 51 Main St., Tuckahoe, N Y The invention relates to an indicating mechanism to be associated with the back of passenger car seats, more particularly on trains engaged in suburban traffic, with a view to circumvent dishonest passengers who purchase tickets entitling them to travel a comparatively short distance and attempt to ride beyond the station to which the ticket has been purchased The general object is to provide an indicating means which is both simple and durable. (See Fig. 21)

CAR DOOR FASTENER. — W Kane, 141 Margaret St., Sarnia, Ontario, Canada. The invention has for its object to provide a device which is easily operable to secure or release the car door in either fully closed or partly open position and which is adapted to secure the door in closed position or in partly closed position as desired in such manner as to admit of ventilation of the car The device is of simple and durable construction.

BRAKE-ROD ATTACHMENT.—J W Connell and J Armstrong, Centralia, Wash. An object of the invention is to provide means whereby the action of a brake rod is cushioned so as to increase the braking power and prevent the brake shoes from being too suddenly applied in case of an emergency application of the brakes. A further object is to provide a rod attachment which may be readily applied to engines, passenger coaches, freight cars or street cars without substantial alteration to the original construction

AUTOMATIC TRAIN STOP.—E. de Leon, Remedios, Cuba. The general object of the invention is to provide an automatic train stop controlled by truck movement, a more specific object being to provide a train stop that will be sensitively responsive to the dropping of the front wheels of the truck to dispose the truck in an oblique position in the absence of a rail in its proper place, the movement of the truck from a normal position serving to actuate valve opening means for applying the brakes.

SLIDING DOOR FASTENER.—H. M. Van Alstyne, 50 Chestnut St., Rensselaer, N Y Among the objects of the invention is the provision of a construction to reinforce the sliding doors of freight cars. A further object is the provision of means whereby the door when moved to closed position can be very easily locked. The fastener is simple and strong, and requires a minimum of parts all of which are easily accessible.

Pertaining to Recreation

PAVEMENT GLIDE. — W. O Carley, 831 N 8th St., Walla Walla, Wash. The invention relates to roller skates or pavement glides. Its object is to provide a glider that will need two wheels only instead of four, and will thereby decrease friction, that will allow the wheels to be of larger diameter with a resultant higher degree of stability, that will provide a brake allowing the operator to come to a stop even when gliding down hill, and at the same time largely eliminate the danger of falling backward. (See Fig 22.)

Pertaining to Vehicles

AUTOMOBILE LOCK. — J H Frost, 341 E. 136th St., New York, N Y This invention relates to a simple and inexpensive anti-shaft device for motor vehicles, and refers more particularly to a lock which covers the slot of the emergency brake, and which when in operative position coacts with the lever of the brake to retain the same in braking position. The device prevents unauthorised shifting of the brake when locked, but does not prevent the car being pushed, in case of fire. (See Fig. 23.)

DUMPING BODY — W. H. Marlow, R. F D No. 4, Trenton, N J The invention aims to provide a dumping body particularly adapted for use in connection with vehicles such as are utilized for the transportation of coal, sand, etc. The primary object of the invention is to provide a body capable of being moved with respect to the supporting member so that it assumes a dumping position, the body being moved to this position by means of mechanism of extremely rugged and simple construction.

BODY FOR CHILDREN'S VEHICLES —D. A. Cameron, c/o J F Hambilser, Houghton, Mich. The invention relates to a top or body adapted to be applied to a sled or the running gear of a baby carriage, and having the general character of the body of a closed automobile. The general object is to provide a body arranged for the convenient placing and removal of a child, with ample provision for a supply of fresh air, the front portion, representing the engine, being used as a storage box

DIRECTION INDICATOR.—O C. Knigge, 140 W 25th St., New York, N Y. Among the objects is to provide means by which the contemplated direction of travel of a motor vehicle may be signaled to drivers of other vehicles, and to provide a device in which the signal may be given at a time before the actual operation of change in direction of the vehicle is performed, the device also indicates the intention of the driver to stop. The signal may be used by night or day

SUPPORT FOR VEHICLES.—J E. Hancock, c/o Charleston Chemical Co., Charleston, S. C. An object of the invention is to provide a support or cradle adapted to support an automobile with the wheels out of contact with the ground, which is automatic in that the car may be elevated by simply running it into the cradle under its own power, the automobile supplying the power necessary to actuate the cradle in the elevating operation. (See Fig. 24.)

PROTECTIVE VENTILATING SCREEN FOR VEHICLES. — B. A. Daniels, c/o Bochardt & Bochardt, 508 Citizens Bank Bldg., Tampa, Fla. An object of this invention is to provide a simple and practical device which is adapted to be detachably secured to a vehicle to protect the occupants of the vehicle from insects, missiles, and other flying objects, such as gravel dust and the like A further object is to provide a device which in its applied position will not obscure the vision or in any way interfere with the operation of the vehicle. (See Fig. 25.)

TOOL FOR REMOVING FROM OR APPLYING DIFFERENTIAL GEARS TO THEIR AXLES —W. C. Bakels, Midland Park, N. J. An object of this invention is to provide a tool for expeditiously removing or associating a gear with its axle by forcing the same into or out of place, thereby eliminating the necessity of hammering or pounding the same. The tool is strong and simple, and particularly adapted for use in repair shops or garages having means for associating the same with an ordinary bench vise. (See Fig. 26.)

REENFORCING STRIP FOR TIRES. —M. B. Peeples, Scotia, S. C. An important object of this invention is to provide a strengthening or reenforcing strip between the flange of the rim and the bead of the tire so that the flange cannot come in direct contact with the bead of the tire and so as to effectively exclude sand, water and the like. The reenforcing strip may be applied by a vulcanizing process or may be placed in position at the proper place and remain separate from the tire.

WHEEL.—R. G Brunner, 935 Moy Ave., Windsor, Ontario, Canada. The invention relates more particularly to a spring or resilient wheel possessing relatively high cushioning capacity and in which the springs which are not under load at any given time do not increase the stresses imposed upon the springs under load, at the same time being adapted to immediately come into action when moved into position to be subjected to load. The parts are readily accessible for purposes of cleaning, replacing and repair

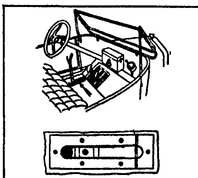


Fig. 23. J. H. Frost's invention locks the car by locking the emergency brake

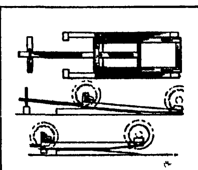


Fig. 24. This ingenious device for quickly jacking up all four wheels of a car was conceived by J. E. Hancock

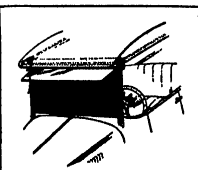


Fig. 25. Drivers who have been stung by bees will appreciate the invention of B. A. Daniels

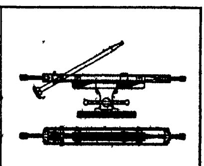


Fig. 26. W. C. Bakels' simple device for removing differential gears

Chemical Processes

COMPOSITION FOR IMPREGNATING WOOD AND PROCESS OF PREPARING IT.—G. Goester, c/o Georgia Vita Ligno Co., Brunswick, Ga. This invention aims to provide a process and substance whereby wood, after being treated with such substance, will become immune from the attacks of destructive animal life for an unlimited length of time, even though submerged and at times exposed, as, for instance, at low tide, to the air The mixture consists of coal oil, bone oil, and crude carbolic acid, heated that they may be condensed to get rid of the ammonia vapors.

Of General Interest

METER BOX.—C. W Blue, c/o Messrs. Janney & Co., Montgomery, Ala. The object of the invention is to provide a meter box closure of simple and strong construction which may be securely locked at a plurality of points and which cannot be unlocked except by a key of peculiar construction, and which when unlocked cannot be removed until rotated to certain defined positions, thus making it highly improbable that the closure will be removed by an unauthorized person.

PAIL CLOSURE.—S. M. Johnson, c/o The Ohio Pail Co., Middlefield, Ohio. The invention particularly relates to the type of pail employed for storing or shipping paint or the like in which the closure must be securely held against displacement. The primary object is to provide a closure which is adapted to be crimped for securing the same to the pail and in which every possibility of unintentional displacement is eliminated, yet the closure is easily removable when desired.

LAZY TONGS.—J G Cornell, 968 Hancock St., Brooklyn, N Y The general object is the provision of a simple and durable mounting for associating the different members of the system. This is accomplished by providing a common shaft on which a pair of the bars of each of the two sets of bars is rotatably mounted, interposing between the bars of the different pairs a bearing, and mounting on the shaft means for forcing the bars toward one another to compensate for wear.

COOKING DEVICE.—M. Kott, 280 E. 10th St., New York, N Y The general object of this invention is to provide a device in which food may be cooked without the use of grease or any means for preventing it from sticking to the cooking vessel. A further object is to provide a drum in which means for supporting the food to be cooked is located, and rotatable means so that when placed above a source of heat a continual change of area is directly in line with the flow of heat.

CLASP.—L. Jabner, P O Box 1665, Station C, Los Angeles, Calif. The invention aims to provide a simple and rugged separable fastener for jewelry which positively insures against accidental separation and resultant loss of the article. A further object is to provide a clasp which functions to permit of relative rotation of the elements whereby the same act as a swivel. A still further aim is to produce a minute device without detracting from its strength.

CRIB COVER.—E. M. Drew, Blanchard Bldg., Barre, Vt. The primary object of the invention is to secure the covers for children's cribs in such a manner that the covers will not be displaced relative to the crib or the occupant thereof upon restless movements, the occupant being free to turn upon one or the other side without disarranging the covers, yet the occupant may be removed and replaced in the crib without disturbing the covers.

METER CONSTRUCTION.—E. A. Kirstein, 447 Delaware Ave., Albany, N Y. The invention relates more particularly to gas meters. An object is to provide a meter of the general conventional type, the parts of which will be modified to virtually preclude distortion or displacement of the crankshaft. A further object is to provide a slide valve actuator, in association with the base of the meter casing in such manner that the base may be readily removed for purposes of renewal, etc.

FOLDING SEAT.—A. Truffy, 15 Impasse Parmentier Courbevoie, Seine, France. This invention has for its object to provide a seat characterized by the features that the legs of the seat constitute the branches of a jointed X, one of the branches being pivoted to the seat, the other to the back, which latter is likewise pivoted to the seat proper, the locking of the branch to the back effected by a suitable device.

DOUBLE-FACED CHANGEABLE-LETTER SIGN.—J G. Williams, 142 E. 47th St., New York, N. Y The object of the invention is to provide a simplified sign capable of receiving different sized letters without adjusting any of the parts, and so arranged that any desired size may be readily applied or removed from either front or rear face of the sign, the size being formed of built-up sections with means for engaging and holding the letters in place.

ROLL FILM HOLDER.—J A. Knorr, 26 Cortlandt St., New York, N Y An object of the invention is to provide a film holder for moving picture cameras which may be readily attached when in use to act as means for supplying unexposed film or as a reel for receiving exposed film A further object is to provide a holder with a hub structure acting in the double capacity of a reel member and a clutch for interlocking with driving mechanism.

MOTION PICTURE CABINET.—A. G Merriman, 416 Dodge St., W Lafayette, Ind. The invention relates to cinematographic apparatus. An object is to provide an ornamental cabinet which comprises a casing having a translucent screen in one side and means disposed interiorly for occasioning the reflection of images of pictures upon the screen A further object is to provide means for preventing the overheating of combustible elements comprised in the apparatus.

APPARATUS FOR TURNING DEEP-WELL BITS WHEN BEING SHARPENED.—J G Schooley and H M Ransdell, Tulsa, Okla. The object of this invention is to provide means whereby the turning of a bit upon an anvil may be easily accomplished with a minimum of labor and without the possibility of being burnt. The invention provides a novel form of pulley with a chain and a U-shaped supporting member adapted to be used in conjunction with the apparatus.

LOGGING HOOK AND LINK.—L. E. Parker, Pe Ell, Wash. The primary object is to provide means for detachably connecting separated elements together in such manner as to normally prevent the parts from being accidentally disconnected. A further object is to provide a hook formed with no relatively movable parts and a link adapted to engage the hook when in a certain position, and prevented from disengaging when in any other position.

LOCKING HINGE.—K. O Gober, 3025 Richmond Ave., Oakland, Calif. The particular object of this invention is to combine with a hinge commonly used as a locking device by means of which the hinge may be prevented from swinging on its pivot. The device comprises a slot in one strip of the hinge and a rigid member secured to the other strip having a projection, and means for locking the projection to the slot.

BOILER TUBE CUTTER.—M. Maher, c/o National Boiler Works, Water St., foot of McKinley Ave., Bay City, Mich. The general object of this invention is to provide a boiler tube cutter which is of simplified construction. The device comprises an elongated body adapted to be inserted into a boiler tube, and a circular cutter so constructed as to move radially outward so that the cutter will sever the tube, on the turning of a handle.

UNIVERSAL WOODWORKING TOOL.—J H. Bloodgood, c/o Wizard Mfg. Co., Box 1312, Tampa, Fla. A purpose of this invention is to provide a motor-operated woodworking tool which permits of the substitution of various forms of tools thereto, so that all the major operations in the working of lumber incident to the construction of wooden buildings can be performed with one and the same tool. The tool can be arranged to accommodate itself to a right or left-handed operator

ADJUSTABLE JAMB UNIT.—C. F Biele, 379 W 12th St., New York, N Y This invention relates to an adjustable metal jamb unit for fitting into a doorway where the wall opening lacks the proper accuracy of dimensions to suit the intended door, as in the case of built-in tile doorways in tile bathrooms and other situations. The general object is to provide a jamb unit composed of elements embodying strength and simplicity.

LOCK.—J Mann, 348 E. 125th St., New York, N. Y An object is to provide a construction which may act in the ordinary capacity of door locks or may act in conjunction with a link as a safety catch for a door when ajar Another object is to provide a locking structure with a locking bolt and a link pivotally mounted on the keeper arranged to co-act with the bolt to present a link safety device for holding a door partially open and at the same time locked.

CREMATORY.—A. C. Felton, Jr., Macon, Ga. An object of the invention is to provide a crematory which affords facilities for utilizing in the incineration practically all the heat generated within the crematory A further object is to provide a simplified construction which embodies an arrangement whereby fuel may be readily fed to the combustion chamber and the heat conducting passages of the crematory conveniently cleaned.

PNEUMATIC SUPPORT.—G Jordahn, Palm Beach, Fla. This invention relates to pneumatic supports especially adapted for use in the water, but may be readily applied for other uses, as, for instance, pneumatic cushions for vehicles or for mattresses. More particularly the device is constructed for teaching the art of swimming or for use as a float employed in the water at the same time retaining the advantages in respect to assistance in learning to swim

STERILIZING CONTAINER.—G M. Gross, Eldorado Springs, Mo An object of the invention is to provide a container having a plurality of compartments, each separate from the other, and each being adapted to permit of instruments to be sterilized or kept in a sterilized condition, and being removably disposed therein, the cells being removable from the outer casing for cleaning or other purposes.

TRAP.—L. C. Accola, Canton, Mo. Among the objects of this invention is to provide a trap in which the clamping jaws also act as an actuating spring means, and in which the jaws are locked in closed position when the trap is sprung, means being provided for varying the spring tension The device is durable, of simple construction and not likely to easily get out of order

FILM DRIER.—J W Hicks and W W Hicks, 2815 14th St., N W, Washington, D C The invention relates to driers especially adapted for drying photographic films. An important object is to provide a drier having means whereby a constant circulation of heated air is maintained, and having a plurality of slidably supported racks with means whereby they may be readily positioned exteriorly of the drier so as to permit of the rapid hanging of removal of the strips of film carried thereby

PIN CLASP.—J Zangrilli, 214 E. 126th St., New York, N. Y This invention relates to devices purposed to retain the corners of soft collars and the like, among the objects is to secure retention without undue strain, to facilitate the insertion and removal of the pin-clasp, to make it possible to leave the holder securely engaged with one corner for future use, while embodying features of extreme inconspicuousness and simplicity of structure.

CLEANING STICK.—H W Routson, 3406 Andover St, Oakland, Calif. The particular object of the invention is to provide convenient means for holding a scouring element such as steel wool in combination with means for saturating the scouring means with soap or a similar cleaner while the same is being used. The device comprises a tube which is adapted to project the cleaning material as required

ADHESIVE.—O Johnson, c/o Johnson, Waterproof Glue Co, 60 California St., San Francisco, Calif The invention relates to the process of making an adhesive composition which consists in extracting the oil from the soya bean, grinding the residue, and then adding to the finely ground residue hydrated lime and sodium fluoride, in about the following proportions, three parts lime, one part sodium fluoride, ten parts bean, and water to desired consistency

VANITY CASE.—W H Denney, Metropolitan Tower, 23rd St., New York, N Y The invention has for its object the provision of a twin compact container of the convenient circular type with an upper and lower compartment in which the regulation size of compact is arranged with an applicator or puff for each, the compartments may be used simultaneously and a convenient mirror is supported by the cover

VANITY CASE.—W G Kendall, 118 Market St., Newark, N J. Among the objects of the invention is to provide a vanity case constituting a main receptacle having an auxiliary receptacle hingedly connected thereto and swinging laterally therefrom. A further object is to provide a hinge by means of which a laterally-swinging receptacle may be pivotally mounted on the main receptacle by the same hinge which forms the pivotal mounting of the cover

ANIMAL TRAP.—J. W Primrose, c/o Mrs. S. W Harlison, 112 No. Hinds St., Greenville, Miss. The invention relates to traps for catching rats, mice and the like, the object is to provide a trap of the ever-set type being always open for the entry of the rodent except immediately after an animal has entered and has closed the entrance prior to passing into the retaining chamber, the device being free of all mechanism within the entrance prevents fright on the part of the animal.

SHOE DRESSING.—S. Cassisa, 314 New York Ave., Brooklyn, N Y Among the objects is to produce an inexpensive dressing of the non-lustre type, adapted for use on canvas and suede shoes which will not render smooth the surface of the shoe, but preserve its original appearance The dressing contains plaster of paris, starch, magnesium oxide, sugar, borax, perfumed glycerine and water to produce a paste

SPACER FOR PAVING BLOCKS.—W. P Whitney, 2600 E. Ash St., Springfield, Ill The object of the invention is to provide a spacer which may be easily and quickly applied to a paving block of concrete, creosote, or the like, or to a paving brick previous to the setting thereof for holding the same properly spaced for pouring or otherwise inserting a filler such as tar and sand.

COMBINATION BILLING SYSTEM.—R. V Newsham, 360 Pine St., San Francisco, Calif This invention has reference more particularly to a combined form which will enable an office transaction to be accounted for in one operation on a typewriter to leave the original bill a so-called expiration record and a copy of the original bill for collection purposes.

AMPLIFIER.—R. P Silverthorn, 223 So State St., Marion, Ohio. An object of the invention is to provide an amplifier which is so constructed that it will bring out tones otherwise lost in the playing of a record. A further object is to provide means for suspending the amplifier directly under the tone arm of a phonograph so that the amplifier does not contact with the cabinet and cabinet vibration is entirely done away with.

TELESCOPE.—M. Lichtman, 172 E. 93d St., New York, N Y Among the objects of the invention is to provide means whereby a plurality of telescoping sections can be fitted and constructed to slide with respect to one another by the use of a minimum number of parts in the construction, which greatly enhances the simplicity of the device, and produces a compact telescope, which is economical to manufacture.

SLIDE RULE.—C. N. Reynolds, Jr., 131 Rochambeau Ave., Providence, R. I. The general object of the invention is to provide a means for illustrating the implications of Einstein's restricted theory of relativity The object is accomplished by providing a rule, including slides, which has a plurality of scales marked thereon for illustrating the apparent effect of the uniform relative motion of two observers upon their respective units of time and space.

LOOSE LEAF CONNECTION.—F L. Martin, c/o A W Swiesy, 4 Bond St., New York, N Y The primary object of this invention is to provide a loose leaf connection for detachably associating the leaves of pages to a binder which eliminates the necessity of employing bolts, split rings, or other standard forms of separable fastening elements for this purpose. As a further object the invention aims to produce a simple and inexpensive connection in the form of resilient clips.

DISPLAY BOX.—A. K. Harned, 161 W 105th St., New York, N Y The invention more particularly relates to boxes for displaying or exhibiting flat goods such as handkerchiefs, underwear and the like. A specific object is to provide means whereby an ordinary box can be converted into a counter or show case without changing its construction and without removing the contents or disturbing the original package.

LIFTING DEVICE.—J Burkley, 4248 No. Drake Ave., Chicago, Ill. The invention relates to a lifting device primarily for use as a kitchen utensil. The general object is to provide a lifting device which may be positioned in a cooking utensil to support

the article of food being cooked so that after cooking the food may be removed from the cooking utensil, retaining it in its original shape.

RECEPTACLE.—I Levy, c/o Nickthausen & Levy, 252 Java St., Brooklyn, N Y One of the objects of this invention is to provide a device especially adapted for containing cakes and similar perishable foods, the device being constructed with sliding doors giving access to the compartments in which the articles are adapted to be placed. The device is simple of construction, and easy of operation, and can be manufactured at a reasonably low price.

Machines and Mechanical Devices

INK DISTRIBUTOR.—D V Kaufman, 2 W 117th St., New York, N Y An object of the invention is to provide an attachment for printing presses which may be bodily applied and removed without injuring the attachment or the press. A further object is to provide an ink distributing construction whereby all parts of a sheet may be supplied with an even quantity of ink and thereby cause pictures and other representations requiring an appreciable amount of ink to all appear alike when printed.

MOLDING MACHINE.—P Dee, 49 Rue Notre Dame des Champs, Paris, France. The invention relates to a molding machine for the purpose of giving to the peripheral part of a molded article an exactly determined height no matter how irregular may be the quantity of plastic material introduced into the mold.

DISHWASHING MACHINE.—U S G Welsh, 90 Prospect Park West, Brooklyn, N Y Among the objects of the invention is to provide means for directing the water effectively onto the dishes in the receptacle of the machine, and means for agitating the water and directing the water upwardly along the sides of the container, the cover being so formed as to direct the water continuously inwardly and downwardly

PUMP.—M. P Ferrer, 357 Hamilton Ave., Brooklyn, N Y The general object is to provide a pump for pumping viscous substances whereby the flow of the material will be facilitated. A further object is to provide a steam jacketed pump cylinder for the heating of the viscous material and to utilize the steam as a motive fluid for turning the pump.

DOUGHNUT MACHINE.—C A Purdy, 5825 Wayne Ave., Chicago, Ill. This invention has for its object the provision of a device in which the amount of dough forced through the cutting die may be varied to produce thin or thick doughnuts. A further object is to provide a machine in which the dough is first drawn into the device and then forced through the die.

METHOD AND APPARATUS FOR SEPARATING MATERIALS.—J. A. Rice, 1165 Arch St., Berkeley, Calif This invention relates to centrifugal ore separators, and more particularly to a form of "trap" by means of which the heavier parts of the crushed ore may be separated from the ore and discharged in a simple and reliable manner An object is to provide a separator which may be easily operated and with which large quantities of ore may be treated at a low cost.

PUMP.—L. L. Ingraham, Gooding, Idaho. The object of the invention is to provide a pump adapted for elevating liquids when submerged in a body of water and having a relatively high pumping capacity It is also an object that the parts be simple and not subject to get out of order, and that the pump be adapted to operate at a very low speed, at the same time deliver a large volume of liquid

ROAD MACHINE.—K. Christenson, Benedict, N D Among the objects of the invention is to provide a machine which is adapted to carry out road building or repairing operations, which is effective in operation to loosen, distribute and pack the material constituting the roadway, which is flexible in its action, easily controlled and of simple and durable construction.

GLASS WASHING MACHINE.—F T Burnham, c/o Burnham Bush Straw Mfg Co., Newton Center, Mass The invention contemplates a comparatively simple machine which is especially designed for handling large quantities of glasses, cups, dishes or similar containers in soda fountains, restaurants or the like to thoroughly clean the articles. Among the principal objects are to provide a machine for saving time and labor, which is automatic in its operation, self-contained and thoroughly efficient, and can be controlled by a person without knowledge of mechanical devices.

SCALE ATTACHMENT.—F R. Wainwright, 256 Jewett Ave., Jersey City, N J. The aim of the invention is to provide a device which may serve as a display or advertising medium for any conventional type of scale, subsequent to its manufacture, or to be applied at the time of manufacture and will be actuated by the movement of the scale mechanism in such manner that persons will notice the advertising or display matter

ELEVATOR.—J G Cornell, 988 Hancock St., Brooklyn, N. Y The general object of the invention is the provision of an inexpensive, simple and durable elevator of the lazy tongs type provided with balancing means that may be located below the elevator cage and which is attached to the lazy tongs system. A further object is the provision of an elevator for mounting in floors or sidewalks, provided with equalizers for adjusting the operating chains on the driving mechanism.

WASHING MACHINE.—F K. Renner and E. C. Pfaff, c/o F K. Renner, 4654 N St. Louis Ave., Chicago, Ill Among the objects of the invention is to provide a washing machine embodying means for causing the circulation therethrough of a cleansing fluid and a continuous flow to the cleansing fluid through articles disposed within an oscillatory receptacle. A further object is to provide a device having means for draining the liquid compartment so that the cleansing fluid may be changed at will.

ADVERTISING DEVICE.—F R. Chester, c/o Chester Pollard Co., 1416 Broadway, New York, N Y This invention relates to a mechanical device wherein soapy water is blown into bubbles which are allowed to fall in a cascade, means being provided for illuminating the bubbles, while in continuous movement, the bubbles bursting and returning to a liquid, which is again blown into more bubbles, the effect produced being pleasing and ornamental.

WATER CARRIER.—H J Daniel, Sutherlin, Va. An important object of the invention is to provide a simple and reliable means whereby water may be carried from a spring to a house or other point of use without the necessity of going to the spring and manually filling the carriers. A further object is to provide a monorail structure having convenient means whereby a truck is held upon the rail at the end of its movement and when the buckets of water have been removed.

JUSTIFYING DEVICE FOR TYPEWRITERS AND THE LIKE.—K. G. O'Bryan and J W O'Bryan, 36 Bryant St, N W, Washington, D C. This invention relates generally to typewriting machines, and more particularly to attachments having for their purpose the justification of lines of typed matter and the graduated spacing of characters in a line, the invention being applicable to typewriters, stencil cutters and other key actuated devices having movable carriages and a normally unadjustable escapement control for the carriage.

WATER CONTROLLING DEVICE.—T Curran, 5643 S. Peoria St., Chicago, Ill. An object of the invention is to provide a water controlling device for turning on and off the flow of water in a water main and which is operated by the water pressure within the main. A further object is to provide a controlling device for railroad standpipes permitting the use of a gate valve which provides a free way flow of water to the standpipe.

CHUCK.—I T Neiland, Hillsboro, N D This invention particularly aims to provide a chuck preferably for a watchmaker's lathe, for securely and adjustably holding a finger ring with its circular band anchored within the chuck and behind an enlarged portion of the band to be machined by applying a suitable lathe tool to the enlarged portion to turn out a so-called flat-top basket stone-mounting.

CENTRIFUGAL CASTING MACHINE.—J D Hammond, 1604 1st St., Jackson, Mich The invention relates to die casting machines in which molten metal is introduced into a revolving flask by centrifugal force. A further object is to provide a device in which a pouring device for introducing metal into the flask is actuated by a mechanism rotating at a predetermined speed

CLOTH LAYING MACHINE.—G Sotelian, 40 Wyckoff St., Brooklyn, N. Y. An object of the invention is to provide a construction which will be automatic in its actions of laying successive layers of cloth in a given space. A further object is to provide a machine with a traveling carriage and gripping means at a predetermined distance apart, the arrangement being such that the carriage travels from one gripping means to the other, back and forth, and automatically lays the cloth as it travels.

ELEVATOR SYSTEM.—W Gromer, 36 8th St., Woodside, L. I., N Y The principal object of the invention is to provide an elevator system involving the use of a plurality of cages and guides, supporting and controlling means therefor, whereby a cage is not limited to ascents and descents in a single shaft, but is also shifted horizontally at different levels for transport from one shaft to another, and a considerably greater number of passengers transported in a given period than in previous systems.

PISTON RING.—J H. Brenner, Douglas, Wyo. The object of this invention is to provide a piston ring which is adapted to expand and contract by the pressure formed between the ring and the piston by the leakage of oil, air or other fluid or gaseous mixture within the cylinder so as to give a proper joint against leakage in both directions of movement, at the same time provide a ring which can be very easily applied and removed in the ordinary way

ELEVATOR FOR SUCKER RODS.—N A. Janney, 208 E. Main St., Ranger, Texas The invention relates to devices for use in handling tubes and sucker rods in deep wells. An object is to provide a device which can be readily adjusted to a sucker rod to support the same in a desired position and to prevent rotation of the rod. A further object is to provide means whereby accidental displacement of the sucker rod is precluded.

TESTING APPARATUS.—C. R. Hill, Box 82, Van Wert, Ohio. An important object of the invention is to provide an apparatus for determining the setting time of cement, plasters, or other compositions possessing the property of hardening, the purpose being to enable the determination of the interval of time elapsing between the compounding of the cement and the hardening of the same The apparatus is simple in its operation.

CONVEYOR.—W H Onion, 2518 Canal St., New Orleans, La. The purpose of the invention is to provide a conveyor of the endless belt type for handling heavy or light articles with equal efficiency, which is comparatively inexpensive to install, durable and consisting of few parts which are adapted to operate in a smooth manner, and with a minimum amount of friction of the movable parts.

COLLAR BURSTER AND EXPANDER.—J A. Woods, c/o Holmes, Yankley, Holmes & Eaton, 506 4th National Bank Bldg., Wichita, Kans. An important object of the invention is to provide a collar burster having simple means whereby the same may be introduced into a well casing and securely and positively engaged with a collar to be expanded so that the section of casing immediately below the collar to be burst may be parted from the sections of casing above.

ANTIFRICTION ROLLER BEARING.—J, T Rice, R. A. Rice and J A. Rice, 1718 Unionport Road, Bronx, N Y The general object of the invention is to provide a bearing of the type that will prevent the entrance of dirt to the rollers, and race for latter, or at least minimize the entrance of dirt, as well as to provide a construction making for facility in the assembling and disassembling of the parts.

MIXER.—T. G Dempsey, 728 E. 163rd St., New York, N Y The invention is primarily designed for use as a concrete mixer The general object is to provide a mixer with means for giving the ingredients to be included in the mixture a helical movement as they pass through a casing to mix them. A further object is the provision of a device for mixing dry mixtures which continuously delivers the mixture, and means for applying water to the dry mixture as it leaves the machine.

MACHINE FOR MAKING RETAINING RINGS FOR RECEPTACLE CLOSURES.—A. Van A. Felsen, 38 Morris St., Danbury, Conn. Among the objects of the invention is to provide a machine in which retaining rings for receptacle closures may be readily and economically constructed and in which a strip of material is flanged along its longitudinal edges and then bent into the form of a ring with the intermediate or web portion in a plane transverse to the axis of the ring.

OIL-SAVING STACK FOR GAS-FLOWING WELLS.—[illegible], c/o O. A. Arnold, Box 447, Breckenridge, Texas. The invention relates to a device for application in connection with gas-flowing oil wells. Its object is to recover from such gas the minute particles of oil carried in suspension therewith and which ordinarily escape and are lost. A further object is to provide a construction which may be readily inserted and removed from effective position over a standpipe, and which may be readily cleaned from time to time.

SPRAYING MACHINE.—J. Paschall, 1411 W Madison St., Chicago, Ill. This invention is particularly designed for spraying paint, calcimine or analogous material over relatively large flat surfaces. An object is the provision of a device by means of which the material may be evenly spread in a minimum amount of time, and in which the quantity and density of the material may be regulated as desired in treating cracks, crevices or inconvenient places.

GIN RIB.—F R. Compton, Blooming, Texas. The invention relates to means for increasing the ginning capacity of cotton gins. An important object is to provide a cotton gin having a plurality of revolving ribs which move between the gin saws and double the ginning capacity but do not affect the usual operation of the gin.

MILLING-MACHINE CUTTER.—J. Mattson, 1834 N Rockwell St., Chicago, Ill. This inventor has been granted three patents of a similar nature, their object is to provide milling-machine cutters which are adapted to cut a piece of work faster than the ordinary cutter without sacrificing the uniformity of cut which is accomplished by the ordinary cutter. A further object is to provide a device which makes use of circular and non-circular cutters and in which the cutters may be readily secured and clamped in position, and provide means whereby the cutters may be turned, whereby the same cutter may be used for a relatively longer length of time.

CLUTCH.—D W. Wood, Brazil, Ind. The invention relates to cone type clutches, its object is to provide a clutch arranged to insure accurate and quick coupling or releasing of the driving and driven members. Another object is to provide a clutch more especially designed for use on the countershaft of high-speed tooling machines to readily overcome the momentum when the clutch is thrown into reversing position, thus reducing the wear of the working members.

GRINDING AND BORING MACHINE.—V Bartley and J B. Worthington, c/o Automobile Service Works, Oklahoma City, Okla. The invention aims to provide a grinding and boring machine particularly adapted to use in connection with cylinder blocks, by means of which even badly mutilated cylinder interiors may be readily reground and finished. The device is simple, and means are provided for supporting the work to avoid undue strains.

GUIDE FOR GRINDING DEVICES.—M. P Schmitt, 1619 Sheridan Rd., North Chicago, Ill. The invention particularly relates to grinding devices used for the sharpening of lawn mower blades and the like. An object is to provide a guide for grinding, in which the depth of the cut about to be made may be accurately determined and in which variation in the grinding of a straight blade due to the elastic properties of the grinding wheel support is reduced to a minimum.

PUMP PISTON.—T. W. Delaney, 691 Aurora Ave., St. Paul, Minn. The general object of the invention is to provide a double-acting deep well pump in which plungers are provided one above another, and to provide simple operative parts characterized by the minimum friction in operation, and discharging the liquid in practically a constant stream. The invention provides a simple form of mechanically operated valve in the plunger with an arrangement of air chamber directly above the cylinder.

APPARATUS FOR CLEANING THE OUTSIDE OF BOILER TUBES.—F. [illegible], Germany. This invention is particularly intended for cleaning scale from tubes, for instance the fire tubes of boilers of portable engines. The apparatus comprises a portable operating mechanism, and an endless band or chain having cleaning tools attached, said band or chain being adapted to pass around the tube; the device may be used on the middle tubes of a bundle of tubes.

The Animal Hospital

(Continued from page 318)

period of work. The largest number of cases always occur just after a holiday that falls on Monday, when horses have been idle Prevention, according to Dr Klein is merely a matter of reducing the rations and taking the horse for a walk. In a single year Azoturia killed 27 horses out of 50 cases

Influenza is the next most common disease to which horses are subject, judging by the records of this hospital In one year 36 cases were reported to the medical clinic The percentage of cures there is much higher only five of the number being lost. Hogs also are subject to a form of the same disease familiarly known as 'hog flu Swine are rarely brought to the hospital, most of the treatments being given by the Ambulatory Clinic which is a traveling hospital fully equipped for all sorts of medical treatment and minor surgical work. It covers a wide territory in the rich farming regions around Philadelphia and an idea of the extent of its work may be gained from records showing a total of 3 413 cases treated in a year including 60 horses, one mule 2230 cattle, 1115 swine and seven dogs

The widely expanded scope of the medical work now being done for animals may be indicated by figures from still another department of this hospital—the free dispensary for large animals Its last annual report shows a total of 626 cases treated under two classifications external and internal In the former were included diseases of the eye, head and neck thorax and abdomen anterior limb, posterior limb The internal diseases included respiratory, digestive nervous skin genito urinary and miscellaneous The hospital even prescribes for general debility for horses

The clinic for small animals however touches a responsive chord in the hearts of those who love animal pets It had 2272 cases last year It trimmed the beaks of pet birds operated on a dog for concussion of the brain and kept him alive removed foreign bodies from the eyes throats and stomachs of cats and dogs repaired all sorts of broken bones and put countless animals on proper diet Every morning from 9 to 11 o clock there is a long procession of pet owners filing into the hospital with dogs cats rabbits, monkeys and parrots under their arms In 2029 cases it was necessary to keep such pets in the hospital for treatment or operations Reference has been made to skunks Strange as it may seem many persons take a liking to the looks of these beautifully striped but odoriferous little animals and decide to keep them for pets In order to make that possible the only thing necessary is to have the scent glands removed after which the civet cat is powerless to use his chief weapon

In his years of experience Dr Klein has made many discoveries concerning the cause of common ailments in pets He is authority for the statement that a large number of the digestive and stomach troubles of dogs is due to improper feeding Even among dog lovers who are presumed to know something about methods of feeding the animals there is a widespread belief that meat is likely to cause fits Therefore all sorts of substitutes are tried, and since it is possible to make a dog eat almost anything if he is hungry enough trouble results

"The dog is a carnivorous animal " says Dr Klein Meat is his natural food It can't hurt him unless, of course he gets too much when he is inclined to gorge Even that will not do as much harm as feeding him vegetables and other foods which his digestive organs were never designed to assimilate Dogs have less intelligence than cats in the matter of food A cat is less likely to overeat, or to eat the wrong foods, even when it has the opportunity The mule likewise, has more food sense than the horse. It would be possible to put 15 mules in a corral with just enough food for fifteen and with some assurance that each would get enough But if that were tried with 15 horses some eating quickly would get more than their share and overeat."

All animals dying or killed in the hospital are dissected by the students or instructors, except where the owners want them returned It has been found that the most humane way to kill large animals is by shooting and a special gun has been designed for the purpose Its muzzle fits into the forehead of the animal, a pin is pressed and the bullet, long but not of large calibre, plows through the brain Cats so badly injured or so diseased that they cannot be cured are killed in a glass topped box filled with gas.

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear in Electrical Notes, Service of the Chemist, Motor-Driven Commercial Vehicle, and other departments

Automotive

The Increasing Average Life of the Automobile.—Two years ago figures were published tending to show that the average life of automobiles was about 5⅓ years. A compilation just completed shows the life of the cars that were manufactured from the fall of 1911 to the fall of 1915 to be about 6¾ years. The statistics on which this result was predicated may be regarded as fairly accurate. The increase in average age is attributed to the fact that there has been no striking developments in body design or important changes in mechanical features since 1912, with the result that there is a smaller tendency to retire a car before it has worn out. Other causes are the improvement of our roads, the multiplication of repair shops, the introduction of the flat rate system of car repairing and the general education of automobile drivers.—*Automotive Industries*, 49:8, pp. 387-8.

A Cooler Motorcar in Hot Weather may be had, according to Dr W W Coblentz of the Bureau of Standards, by applying aluminum paint to the under side of the top and a white reflecting paint to the upperside. The ordinary black automobile top absorbs about 90 per cent of the solar heat which reaches it and a large part of this heat reradiated on the under side. The effect is about the same as that which would be reproduced by having a hot water radiator in the top. The application of the two kinds of paints named should reduce the temperature inside of the car to that of natural shade such as is had under a tree. It was found that white paint is a better reflector and a poorer absorber of sunlight than aluminum paint, but the latter is far better for preventing the passage of long heat waves off at lower temperatures.

A Worm-driven Street Car has been constructed in England as an experiment and tests already made on it have given very satisfactory results. The silence in running was remarkable as nothing could be heard beyond the rolling of the wheels on the rails. A further advantage has been gained by the use of differential, in order to do away with slipping and grinding in rounding corners. By the use of ball and roller bearings throughout a saving in power of about 20 per cent is made The car has two motors driving propeller shafts and worms on opposite ends, so that there is traction on both pairs of wheels.—*Tramway and Railway World*, 54:3, pp. 9-11.

The Gasoline Motor Rail-car. It has been found, whenever the gasoline rail-car competes with auto-bus lines that the former has finally won out. The bus lines cannot operate reliably in bad weather, and the public seems to prefer the smooth running gasoline rail-cars to riding on the highway buses. The buses have had no difficulty in taking the cream of the local traffic as long as they were in competition with regular steam service, but the advent of the gasoline motor has introduced an element of novelty that has proved attractive. The largest car of the rail type thus constructed has been placed in operation on the Chicago Great Western Railway. This equipment comprises a two-car train with a seating capacity of 74 passengers and a total weight of 61,000 pounds. The motive power is supplied by a 6-cylinder gasoline motor which develops 180 horsepower at 1250 revolutions per minute. Using four speeds forward, with normal engine speed, 48 miles per hour is possible.—*Railway Review*, 73:6, pp. 201-5.

What May Prove to be an Epochal Move, bringing about extensive changes in existing laws relating to motor vehicle operation, and through these, important changes in motor vehicle chassis and body design, is the suggestion of a Yale professor as a result of his chemical investigations of the air in our large cities. It was shown that the air is being heavily polluted with carbon monoxide gas. The air affected by the exhaust of a moving car is in the shape of an elongated, horizontal cone extending some 30 feet back of the exhaust and from 5 to 15 feet above street level. Investigations recently made by Professor Henderson show that the contamination of the air in the more congested streets of New York often reaches the upper limit of a well-founded health standard, and sometimes exceeds it. To a great measure the carbon monoxide is generated as the result of carburetor adjustments that give maximum engine pull. The rich mixture wastes a third of the fuel value of the gasoline and generates much excess carbon monoxide in the exhaust. Buses contaminate the air for a distance of 100 to 200 feet behind them with three to four parts carbon monoxide. The suggested remedy is a vertical exhaust reaching the top of the car, above the level of the heads of passengers in vehicles following. The gases are therefore kept from being drawn into the wake of the car The vertical exhaust is already being used by New Haven baker's trucks in order to protect the bread.—*The Automotive Manufacturer*, 65:4, pp. 27-8.

Tests of the Tractive Resistance of Pavement Surfaces were made in order to ascertain the relative cost of operation of motor vehicles on concrete, on gravel and on a non-rigid type of pavement. On each test a distance of 100 miles of continuous operation was run at speeds between 20 and 30 miles per hour The conclusions were that between concrete and the non-rigid or bituminous type of road there is practically no difference in gasoline consumption On gravel or macadam roads in good condition the gasoline consumption is from 10 to 35 per cent higher Under modern volume of traffic good roads pay for themselves in economy of gasoline consumption and in economy of tire and other wear and tear On a road carrying 2000 vehicles per day the saving on gasoline affected by hard surfaced roads is about $4000 per mile of road per year. To this must be added the wear and tear on tires and other parts, which must be as great as the cost of excess gasoline. To this must further be added the saving on road maintenance cost in order to get an object lesson on the economy of good roads.—*American City*, 29:2, pp. 124-5.

Civil Engineering

Broken Coral Reefs as an Aggregate for Concrete.—A resident of the Dutch West Indies has been experimenting with broken coral rock which abounds on the beaches of that region, with a view to its use in an aggregate for concrete. Thus far it has proved wholly satisfactory and has been used for the construction of floors, the covers for septic tanks, for drain pipes and for building purposes. In the case of a building that was to be constructed of such concrete, the material dug up in excavating the foundation proved to be sand and coral stones so well proportioned by nature that it was only necessary to add cement to it in order to have a first class concrete.—*Concrete*, 23:2, pp. 55-7.

Fourteen Billion Particles to the Cubic Inch represents the fineness of Portland cement, according to the estimate based on specially equipped investigations made by the Structural Materials Research Laboratory at Lewis Institute, Chicago. By means of an instrument known as an air analyzer a number of samples of cement were separated into groups of particles of different sizes. The average size of the largest particles in each group was then determined by microscopic measurements and from these measurements what are known as separation sizes were determined. Naturally, it is impossible to make

an accurate estimate of the number of particles in a cubic inch of cement. However, from data gained from these tests with the air analyser, it appears probable that about 6,000,000 cement particles could be placed in a single layer on a piece of glass one inch square. In a cubic inch, then, there would be approximately 14,000,000,000 of these particles, instead of only 40,000,000 or so that would occupy that space if all the particles were just small enough to pass through the openings of the 200-mesh sieve (.003-inch square) which is the size usually used in making the regular test of the fineness of cement.—*Cement, Mill and Quarry*, 23:2, p. 42

The Proposed Bridge Across the Golden Gate at San Francisco would span a gap of 6800 feet and for this purpose would have a 4000-foot center span and two shore spans of 1320 feet each. As the self-weight of the cantilever limits its spans between piers to about 1800 feet maximum a bridge is proposed which combines the cantilever and suspension principles. The cables of the suspended span, instead of extending the full length of the center and side spans, tie into the ends of the cantilever arms at points which are so selected as to secure the economical length for both types of construction. In this case, for the single span of 4000 feet there would be needed only a suspended cable span length of 2640 feet. This design is known as the "cantilever-suspension" bridge. The span will provide a clearance of 200 feet for the passage of ships. The two main piers will be 200 feet from base to top, and superimposed on them will be steel towers 747 feet high. Their maximum width at the base will be 115 feet. The total length of the bridge proper is 6640 feet. The two main cables will be 20 inches in diameter. The cross-sectional width of the bridge is 80 feet, providing for two trolley tracks, two lines of motor cars in each direction and two 7 foot sidewalks. The center span is 2400 feet greater than that of the Manhattan Bridge and 750 feet greater than that of the proposed Hudson River Bridge. The estimates call for a total cost of about $17,000,000.—*World Ports*, 11:10, pp. 101-7

Experiments with Rubber Paving are being made in England. Large slabs of rubber two inches thick are to be used, each slab weighing about 600 pounds so that creeping and lifting will be reduced to a minimum. The surface of the slab is corrugated, giving a safe foothold for horses. The whole is placed on a concrete foundation and the joints are cemented with tar.—*Canadian Engineer*, 45:6, p. 212

A New Type of Caboose for freight crews has been built by an Ohio railway company in order to provide a different method of train inspection from that furnished by the conventional cupola. The new design employs side-bays and does away with all overhead structures. These side-bays are provided with tall, narrow observation windows at each end of the bay, and these permit the trainman to see along the train. The windows are hinged, allowing them to be opened and allowing the familiar smell of a hotbox to reach the trainman. As the side-bay observation windows are lower down than the cupola windows, the hotbox scent is much more likely to be observed by the trainmen. The bays are provided with seats so that the trainman may keep his train under observation much better than when the cupola caboose is used.—*Railway Age*, 75:6, pp. 287-9.

General

Bootlegging in Rubber is one of the reasons why the recent effort of the British rubber growers of India to restrict the world supply has largely failed. The British grow about 70 per cent of the rubber used in the United States. The price of rubber in 1921 and 1922, before the Stevenson restriction plan was adopted, ranged from about 13½ to 19 cents a pound, while the fixed charges of the average rubber plantation, before a pound of raw material is produced, are about 18½ cents. When the success of the plan seemed assured, in 1923, rubber boomed, the price rising to about 36 cents and automobile tires reflected this rise in cost. Some months later prices began to sag and in June of the present year had already fallen to about 25 cents. The two chief causes of this sag in the price of rubber are, first, the Dutch East Indies plantations, which are not included in the plan, produce over a quarter of the world's output, second, there was great difficulty in enforcing the restriction among the British planters themselves. There was considerable illicit trading in the permits necessary to export specific amounts

of rubber as well as forging of these permits.—*The Industrial Digest*, 2:8, pp. 878-9.

A New Filtration Principle has been devised by an English scientist, Dr Hele-Shaw who conceived the idea of filtration through the edges of a large number of sheets of rough, impervious paper pressed tightly together this being an entirely different conception to the usual one of filtration through the surface of a sheet. Each sheet of the waterproof paper is perforated with an identical number of holes, forming tubes when the sheets are superimposed in such a way that large and small holes are in alternate rows Demonstrations made on muddy water mixtures of oil and water dyestuffs and dirty engine oil gave a complete separation.—*Chemical and Metallurgical Engineering*, 29 4 p 148.

Deciphering Charred Papers is the subject of scientific paper issued by the Bureau of Standards wherein is described a new method of reading records that have been subjected to such intense heat in the closed atmosphere of a fireproof safe during a fire that they have charred into carbon without being reduced to ashes The photographic plate it was known is sensitive not only to light but to certain gases and vapors In the preliminary tests a sheet of this carbonized paper was placed between two fast photographic plates and left in the dark during 14 days When developed, a perfect copy of both the printing and the writing was obtained Furthermore the imprint of the writi g which was on the back side of the charred paper was retained by the plate though more faintly than the other It was found that after some days of exposure to the air the records largely lost their power of making an impression on the plates. Results were obtained with a Seed 30 dry-plate—*Brass World* 19 7 p 236.

Galvanized Iron Utensils Sometimes Cause Poisoning of those who drink liquids that have been stored in them according to a warning issued by the Bureau of Chemistry of the United States Department of Agriculture In a recent instance of poisoning resulting apparently from the presence of zinc 12 men at the Guam Naval Station had each drank a bottle of root beer and immediately began vomiting Chemical examination of the contents of three of the bottles disclosed the presence of substantial q iantities of zinc salts in each bottle Fxperiments carried on by Federal chemists with quantities of lemonade orangeade, m lk carbonated water Washington city tap water and distilled water held over night in galvanized iron buckets proved that zinc contamination occurred in each case.

Industrial Progress

The Electric Steam Boiler under certain conditions is an economical means of making steam Cheap energy m st be available during at least part of the time This energy may be surplus power purchased under a block rate but not used With such condi tions the money saved on coal may often pay for the electric bo ler in a short time. A boiler of tl is type requires no heavy founda tion or large building It has no smoke-stack and no fuel storage There is no handling or stoking The operation is simple and requires few men There is no smoke dust or ashes The boiler has a thermal capacity in tl e neighborhood of 97 per cent and it will generate steam at any pressure The electric boiler generates steam by pass ing current directly through the water In its simplest form the water resistance boiler is nothing but a water rheostat. All the energy p it into the boiler passes into the water—*Industrial Engineer* 81 8 pp 408 5

Using a Mass of Hot Water for the Storage of Steam in the form of heat is the basis of the steam accumulator whose practical application to steam at pressures considerably above atmospheric is a recent European development Among the advantages gained are smaller boiler capacity and higher boiler efficiency There is also a commercial saving at the point of utiliza tion due to the fact that the accumulation can easily supply any surge of steam caused by putting a cold piece of apparatus suddenly on the steam line. Such apparatus may also be heated up as fast as it will take the steam often increasing the productive capacity of the manufacturing plant. One class of application is that in which a cheap source of by product heat is available in variable amounts and cannot be as cheaply stored by other means, as in the case of gas produced as a by product in the manufacture of steel and coke. The accumulator is

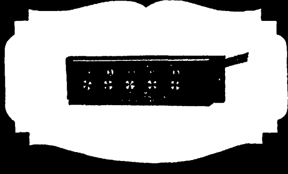
practically a "fly-wheel" for steam. It works on the principle that the amount of steam that can be stored in hot water depends upon the allowable variation in temperature, and hence in pressure. It soaks up excess steam when the pressure rises and gives it off again as it falls. The steam accumulator in Europe has found its principal application in plants where large amounts of process steam are used in widely varying amounts, notably in pulp and paper mills. It permits short peak demands of practically unlimited intensity.—*Power*, [illegible]:2, pp. [illegible].

The Recovery of Ammonia from Hydrogen and Nitrogen with a minimum of expense and effort as compared with the higher cost of producing it in by-product coke ovens is the goal of a group of workers in a Government laboratory at Washington. An experimental compressor has been devised and put in use and is developing pressures up to 15,000 pounds per square inch. It is expected that the research work will furnish the data necessary for the installation and operation of small ammonia plants throughout the country. The direct synthetic-ammonia process for the fixation of atmospheric nitrogen is the newest of the three processes which have been brought to a commercial stage. In this process a purified mixture of nitrogen and hydrogen is subjected to a very high pressure and brought in contact with a suitable catalyst, and is maintained at about 932 degrees Fahrenheit. Under these circumstances, nitrogen and hydrogen combine chemically to form ammonia in quantities from 5 to 15 per cent of the gases present. The ammonia so formed is removed, and the uncombined gases are returned to the apparatus and again treated. Estimates indicate that a plant capable of converting 100,000 cubic feet of hydrogen into 2000 pounds of ammonia can be constructed for $50,000. In such a plant, ammonia could be produced at from six to seven cents per pound, exclusive of royalties and cost of hydrogen.—*Compressed Air Magazine*, 28:8, pp. 599-600.

Precooling of Cantaloupes in water kept slightly above the freezing temperature is a new method of avoiding loss in shipment from the Imperial Valley of California to the East. The melons are unloaded beside an endless platform carrier, which takes them in crates down an incline and through the watertank. The water in the tank is maintained at a temperature between 38 degrees and 40 degrees Fahrenheit by ammonia coils. The cantaloupes are carried slowly through the water, remaining in the tank about 90 minutes and coming out with a uniform temperature of 40 degrees Fahrenheit. They are loaded immediately into the cars and started to the city markets. Extensive tests were made to see whether water would penetrate the cantaloupes, rendering them soggy inside and probably promoting mold, but none of these difficulties has been experienced in the early experiments.—*Ice and Refrigeration*, 65:2, p. 59.

Naphthalene for Internal Combustion Engines.—Coal tar provides, when refined, two fuels for internal combustion engines, a liquid and a solid. When cooled, the bulk of the distillate is liquid, and this liquid has been extensively utilized in Europe as a fuel for Diesel engines. The solid is chiefly naphthalene. This may be centrifuged and recrystallized, giving, by a very simple process, a hydrocarbon sufficiently pure to serve as a fuel for internal combustion engines. Naphthalene has been used successfully as a substitute for gasoline in the propulsion of motor cars. Its boiling point lies within or close to the boiling point range of much of the gasoline sold in the United States. To drive such motors requires some modification of the ordinary feeding and carbureting mechanism. Most motors feed the naphthalene in liquid form, and are constantly obliged to start and run for a short time on gasoline. If all the coke-oven and coal-gas tar burned by the consumers in the United States in 1920 had been treated in a continuous still for the removal of oil and the production of pitch there would have been obtained about 40,000,000 gallons of distillate, or fuel to furnish a Diesel engine with 100,000 horsepower years.—*Gas Age-Record*, 52:4, pp. 96-7.

Sirup from Sweet Potatoes may be manufactured at a cost of about 65 cents per gallon, according to Department Bulletin [illegible] of the Bureau of Chemistry of the United States Department of Agriculture. Laboratory experiments made by the Bureau indicate that about [illegible] gallons of sirup to a [illegible] of sweet potatoes may be



obtained. The new sirup has possibilities for use as a table sirup, for cooking and in the manufacture of candies such as taffy and caramels.

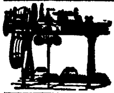
The Arc-Welding of Steel Buildings has not progressed greatly, owing to a lack of confidence in the process on the part of architects and engineers. A few structures, ranging from small sheds to 40 by 100-foot buildings have been erected without a single rivet being used, all structural members being electric welded. A 125-foot cross-channel barge and a 500-ton coastwise vessel were constructed in England and were completely arc-welded throughout. Undoubtedly there is a big future in the structural field for the arc-welding process and the building departments of our various cities will soon recognise this as a standard method of construction.—*The Welding Engineer*, 8.7, pp. 21-3.

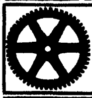
A Novel Method of Doing Concrete Work was put into use at the Lake Placid Club in the Adirondacks last winter when it was desired to build a new clubhouse measuring 44 by 210 feet and six stories high during the winter months. In this region the temperature reaches a point as low as 50 degrees below zero. As it was impossible to complete the building in time for its use in summer unless work went on all winter the contractor built a wood shell that covered the building completely and kept it safely warm for concrete work and comfortable for labor Not an hour was lost all winter Better men were available at lower wages and when others were just starting spring concrete work the outer shell was torn down and the six-story building was ready for the inside finish The shed used to enclose the job was built to extend five feet outside of the building lines in order to provide working space. It was constructed of two by six uprights on 32-inch centers, sheathed outside with seven-eighths inch hemlock and box spruce and lined inside with tar paper For this immense enclosure, 150,000 board feet of lumber was used but the bulk of it was later salvaged and used in other work. The cost of this winter weather protection was about 10 per cent of the contract price. After the shed was roofed over it was heated, the coal consumption averaging 3½ tons per day The heated air was distributed through wooden ducts and artificial lighting was provided inside the building The temperature was kept at an average of 55 degrees. Only once did the temperature inside register below 32 degrees and the outside temperature at this time was 32 degrees below zero.—*Concrete*, 23 2, pp. 59-60.

A New Method of Butter Manufacture is now being tried in Holland and is meeting with success in delaying the deterioration of butter The new process consists in churning in an atmosphere of pure carbon dioxide The air is sucked out of the churn and is replaced by carbon dioxide, which fills the pores of the butter and keeps out the oxygen so long as the butter is not vigorously agitated after exposure to the air. The natural process of deterioration is accelerated by oxygen The cost of the new process is said to be negligible in view of the advantages gained.

The Microscopical Investigation of Coal is assuming considerable importance of late. Sections of various samples are carefully prepared and studied under the microscope. It is generally recognized that two coals may have identical chemical compositions as determined by customary methods of analysis, and yet one may be applicable to a process for which the other is wholly unsuited. As a result of microscopical analysis Mr A L. Booth divides coals into three main classes: (1) Humic coals, composed of leaves, stems and broken down woody tissues, together with some spores. (2) Spore coals in which spores predominate. (3) Cannel coals, containing small, round, yellow bodies, which, it is suggested, are algae or microscopical animal life. For steam raising, humic coals which contain a portion of cuticle are most suitable, according to the above-named investigator For town gas manufacture, coals containing a considerable percentage of spores should be chosen For producer of gas work, spore coals are best. The best coking coals are those containing yellow resinic constituents. —*Gas Journal*, 163:3142, pp. 422-3.

A Special Rotator for the Study of Color is the solution of a problem which has defied the efforts of German scientists for many years. The study of color is important to the textile and advertising trades. The new machine permits more delicate de-





termination of color effects than any hitherto possible. The unique feature of this machine is that it permits *very* nice adjustments of color relations to be made on a whirling disc while the disc is in motion For instance a yellow disc is placed on the machine and the blue disc is placed partly over it. The two colors blend and the proportions of each color may be shifted by the operator without stopping the discs through the use of an ingenious system of cams and levers —*Color Trade Journal* 13 2 p 56

Vitreous Enameling with Electric heat has within recent years developed into a large industry The electric furnace has demonstrated that it is without a peer when the results from its use in baking vitreous enamel are compared to fuel fired furnaces The control of the heat flow is so complete that uniform temperature may be applied in baking a complex shape even though the heat flow or heat quantity varies in different parts of the charge In case of apron bath tubs for instance no difficulty is met in delivering the required amount of heat at the same temperature on either the apron or reverse side of the tub and such manipulation of heat is impossible with other than the electric furnace In addition to the temperature control the electric furnace is possessed of a long life and low power consumption Sulfur fumes which are injurious to enamelware are absent in the electric furnace and its use secures against high percentage of rejections from this cause The electric furnace has no noises to muffle such as are experienced with coal and oil firing It has been able to handle 170 heats in 10 hours as against 180 heats with the coal fired furnace Heats have been completed in 50 seconds that would require 3 minutes 40 seconds in the oil furnace —*Journal American Ceramic Society* 6 7 pp 794-8

Mechanical Engineering

A New Method of Joining Pipe Joints for artesian wells has been developed during the past few months By use of the oxyacetylene flame screwed joints as heretofore used may be done away with and the well casing will become a single tube of indefinite length Oil well casing has been oxyacetylene welded some years but artesian well casing is usually larger and requires a different type of joint In the case of a well being sunk in New Jersey nine 20-foot lengths of 18 inch steel pipe three-eighths of an inch thick were used First four lugs were welded on the outside of one end of each section of pipe with half the lug extending beyond the end Properly to allow for contraction sections of casing were prepared for welding by separating them about one sixteenth inch with small steel wedges which were melted into the joint as the welding progressed —*Oxy acetylene Tips* 2 1 pp 10-11

Studies on the Hot and Cold Working of Brasses made recently in Germany in a laboratory indicate that all brasses beginning from copper and ending at 58 42 and even somewhat richer in zinc composition can be pressed and drop forged at any temperature below the range of zinc evaporation It was found that the application of the pressing load or of the live force of the falling hammer must be individualized for each particular brass. No attempt to work all of them in the same condition or by men accustomed to some particular conditions can be successful Probably the investigators conclude there is a great influence due to the time factor that is the comparative amount of time needed successfully to produce a suitable reduction under a given load or reversed —*The Metal Industry* 21 8 pp 818-21

A New Type of Diesel Engine has been invented and put on the market by a well known manufacturer This engine uses less compression and has a lower exhaust temperature than present types of Diesels The secret of construction lies in the method of introducing the oil to the cylinder and its combustion therein Acting under the belief that air compression of from 250 to 300 pounds gave ample heat to ignite oil in globular drops the inventor devised a method of uniting oil and air under proper conditions for a continuously recurring engine cycle. By using a check valve through which oil is admitted to the center of a burner composed of an inner and outer sleeve so positioned and proportioned that they form a small combustion chamber between the sleeves, and a relatively larger combustion chamber within the inner sleeve this is accomplished Both sleeves are open at the bottom, and the two combustion chambers are open at the bottom and communicate at

the top through small holes in the inner sleeve. Attempts to run with lower compression and temperature have heretofore usually resulted in faulty ignition and misfiring. No such troubles are experienced with the new engine. By this advance the design of Diesel engines is so simplified that 35 to 40 per cent of the weight, and many moving parts are eliminated.—*The Marine News*, 10 :3, pp. 61-2.

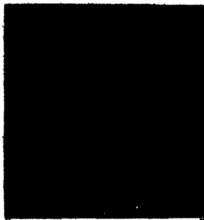
A Chimney Gas Scrubber of unusual and effective design has been installed in a New Hampshire power plant, and has proved entirely satisfactory for the elimination of cinders and unburned coal under the exacting conditions imposed by the manufacturers of paper Waste gases are drawn from the boilers by induced draft fans which discharge downward into a chamber connecting the fans and chimney, causing the gases to strike and follow a curved surface over which water is continually flowing. The momentum of the dust particles causes many of them to strike this curved surface and be washed away to an open trench sewer The connecting chamber is considerably larger in cross-sectional area than either the fan outlets or the stack. Therefore the gas velocity decreases and the dust particles drop out.—*Power Plant Engineering*, 27 :16, p. 818.

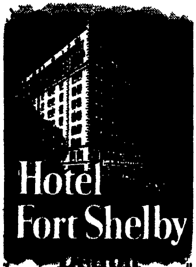
The Development of the Electric Furnace for steel founders in the United States has been of extraordinary interest. The first electric furnaces to make steel for castings in America were installed in 1906, when 55 tons of such castings were produced. In 1920 this output had grown to over 170,000 tons. Expansion of this division of American industry during the last decade has been 2000 per cent. Factors that have caused this growth include the quality of the product, the availability of reasonably priced electric power, and the high price attending the scarcity of coke suitable for use in converter practice.—*Iron Trade*, 73 :4, pp. 348-52.

Metallurgy

The Possible Use of Oxygen or Oxygenated Air in its application to the blast-furnace smelting of iron, the bessemer and open-hearth processes for steel, the manufacture of artificial gas and the blast-furnace smelting of ferromanganese is forecast by the Committee for the Application of Oxygen in Metallurgical and Allied Industries. The trend of development in smelting and refining is in the elimination of inert matter which does not enter into the reactions in the furnace and which simply pass through, absorbing and carrying away heat and reduced metals. In the production of one ton of pig iron three tons of nitrogen is passed through the furnace. To diminish this loss, oxygen might be substituted, or a mixture of oxygen and air Doubtless the application of oxygen will revolutionize the art of smelting and it will probably change the whole operation and equipement, and will decrease the production costs, increase the output per furnace, better the uniformity of the product by permitting a much closer chemical control. It will make possible the use of cheaper materials, ore of lower content and coke of a higher ash, and, it is believed, will reduce the sulfur content of the iron.—*Chemical and Metallurgical Engineering*, 29 :7, pp. 272-5.

Steel Ingots Replace Those of Cast Iron.—The majority of ingot molds are made of cast iron. There has, however, always been more or less interest in steel ingot molds and extensive experiments have been carried out at several plants without successful results. Fr Schivetz, of Krompach, Germany, describes in *Stahl und Eisen* his success in replacing cast iron molds with those of steel. The molds used are the square ones for three-ton ingots. During the War the life of the molds steadily sank from 150 heats to 70 heats. Accordingly, in 1916 six steel molds were made and later the cast iron molds were entirely replaced by steel and the latter have been in use ever since. The average life of all the steel molds used so far is 235 heats, with a constantly increasing life. However, great care must be taken when pouring into steel molds as they are more easily burned than iron ones. After use the molds were placed on a rail-rack and used again only after eight to nine hours. In only a few cases was distortion of the molds noticed, and it is believed this came from improper handling. The carbon of the steel used varies from 0.35 to 0.45 per cent. The manganese is usually from 0.5 to 0.8 per cent. The phosphorous shows a maximum of 0.09 per cent. The sulfur has as 0.07 per cent maximum, and the silicon about 0.15.—*The Iron Age*, 112 :7, p. [illegible].





A New Method of Manufacturing Aluminum whereby clay is mixed with pyrites and heated about 500 Centigrade has been invented in Germany On continuous calcination in a stream of chlorine gas evolved from sodium chloride, with the addition of carbon, the resulting reaction product decomposes into aluminum chloride which is then mixed with sodium chloride to which are added potassium chloride and small quantities of strontium chloride. Transformation into metallic aluminum and chlorine gas is then effected by the usual thermo-electrical means. No cryolite is used, nor is it necessary that the clay should have a fixed proportion of silicic acid present. Moreover, in this process the chlorine gas necessary to form the aluminum chloride is not wasted.—*Canadian Mining Journal*, 44 31, p. 582. Reprinted from *Aluminum*

Magnesium Alloys.—Metallurgists and engineers have of recent years sought to apply light metals and alloys for a great variety of purposes. More recently the magnesium alloys have received attention, because they are still lighter than those of aluminum. At first there was difficulty in producing strong enough structures with these alloys, but the French metallurgists claim to have overcome this drawback.—*The Mining Magazine*, 29 1, p. 2.

Stainless Steel comprises a series of steels containing about 11 to 14 per cent of chromium and carbon, varying to suit the mechanical properties desired, but for most purposes less than about 0.4 per cent. It often contains small amounts of nickel, up to about one per cent. This element, which is generally present accidentally, has no appreciable influence on the non-corrodibility of the steel, but may have a considerable effect on the temperature used in heat treatment operations. Broadly speaking, in order to obtain a ferrous metal which shall be incorrosible, it is necessary first to render iron insoluble in water by suitable alloying and to make the resulting alloy as homogeneous as possible by heat treatment in order to avoid galvanic effects. It is found that the presence of a sufficient amount of chromium in solution in iron reduces the solubility of the latter in water practically to zero. When chromium is added to steel, however, part of the chromium combines with the carbon present to form a carbide. In a typical stainless steel the chromium and carbon are in the proportion of about ten to one—*Mechanical World*, 74 1908, p. 58. (Continued in Nos. 1909 and 1910.)

Hot Rolled Monel Metal has an ultimate tensile strength of over 41 tons per square inch cross-section at 82 Fahrenheit. This is greater than the ultimate tensile strength of mild steel by some 10 tons. The corresponding ultimate tensile strength of cast monel metal is under 25 tons per square inch, but at 1472 Fahrenheit the strength of the cast metal is greater than that of the hot rolled metal. Experiments made in Great Britain serve to bring out the great strength of monel metal at high temperatures. It is especially suitable for all parts controlling superheated steam. Monel metal is a natural alloy of 67 per cent nickel, 28 per cent copper and 5 per cent of other materials. It has a very high resistance to corrosive action by salt water, atmospheric conditions, alkalies and some acids. Superheated steam at 750 Fahrenheit has no appreciable effect on it.—*Marine Engineering and Naval Architecture*, 46:551, p. 303.

A New Magnetic Alloy of Very High Permeability has been discovered. It is a composition of about 78.5 per cent nickel and 21.5 per cent iron and at magnetising fields in the neighborhood of 0.04 gauss, and with proper treatment, it has a permeability of as high as 90,000. This is about 200 times as great as the permeability of the best iron for these low magnetising fields. This high permeability is attendant upon proper heat treatment and upon other factors, among which is freedom from elastic strain. The presence of other elements than iron or nickel, and, especially, carbon, reduces the permeability, but slight variations in heat treatment produce large changes compared with those due to small quantities of impurities. So far as discovered, other physical properties show no peculiarities at the composition which brings out the remarkable magnetic qualities of permalloy. The equilibrium diagram, electric conductivity, crystal structure, mean spacing between adjacent atom centers and density are among the physical properties which have been studied. To the engineer in electrical communication the development of permalloy is very significant. It assures a revolutionary change

in submarine cable construction and operation and promises equally important advances in other fields.—*Bell System Technical Journal*, 2 3, 101 11

Contraction and Shrinkage of Non-Ferrous Alloys as related to casting practice are being investigated by the Bureau of Mines In foundry practice patterns are usually made on the basis of a general figure for lineal contraction of a given class of alloys such as those of aluminum brasses or bronzes irrespective of the alloy employed In making light aluminum castings a general figure of 0 156 of an inch per foot is employed as the pattern allowance But measurements made by the Bureau of Mines show that in 40 alloys the range is from about 95 to 1.8 per cent. It was found that the linear contraction af an alloy is a function of the exact chemical composition of that alloy and relatively small amounts of impurities affect the contraction This wide variation of contraction among the alloys of a given class indicates that it is poor practice to employ a rough figure as the contraction of a given class in general Other things being equal the smaller the cross section the less the contraction for a given length the greater the length for a given cross-section the less the contraction.—*Brass World*, 19 7 pp 231 5

Mining

Rubber Linings for Ball Mills are a recent development in the mining and ore milling industry Cylindrical and conical ball mills consist of thick steel or gray iron shells with heavy linings that may be removed when worn In order to resist the abrasive action of the ore these linings are chrome or manganese steel castings from two to three inches thick These linings wear out the outer shell owing to the constant friction between the two aggravated by small particles of ore The condition is so serious that the tendency is toward making cast steel shells as much as 1½ inches thickness As a rule linings have to be replaced three times in two years Experimental ball mills are now in operation wherein sheets of rubber are used in place of the steel linings These rubber sheets are seven to eight feet long sixteen inches wide and five eighths of an inch thick and are cut to fit the inside dimensions of the mill By their use the lining weight is reduced effecting a saving in power of about 24 per cent. Due to moisture in the ore the inside of the shell of the mill is soon covered with rust to which the rubber freezes holding it firmly in place and eliminating friction between the lining and shell thus preserving the latter The cost of the rubber lining is less than that of chrome steel while its decreased thickness materially decreases the capacity of the mill Observations have shown that the ore and the balls instead of sliding readily over the surface cling to the rubber thus increasing the working zone The rubber lining lasts about half again as long as that of steel and the relining is a shorter operation The process has evidently passed the experimental stage and seems established —*The India Rubber World*, 68 5 pp 697-8.

Investigations of the Value of the Carbon Dioxide-Oxygen Mixture in the treatment of carbon monoxide asphyxia, especially with the object of finding the proportion of the mixture that is most efficient for administration and of determining the advisability of its use by first aid and mine rescue men are being carried out at the Pittsburgh experiment station of the Bureau of Mines So far the investigations indicate that while carbon monoxide is eliminated more rapidly from the blood by the use of the carbon dioxide-oxygen mixture than by any other method there is the possibility of instances occurring in which its use might be a disadvantage unless administered by a physician —*Coal Mine Management*, 2 7 p 31.

The Advantage of the New Liquid Oxygen Explosives are low cost, less than one-third that of dynamite the absence of danger from misfire and accidental explosion the absence of poisonous atmosphere —in fact, it improves the air adding oxygen an increased output of 50 per cent per miner; the possibility of using inexpert labor for charging and tamping it the elimination of the cost of detonators the entire elimination of accidents through drilling into unexploded holes and finally its safety of transportation —*Iron and Coal Trades Review*, 107 2891, p 129.

The Trench Hat, "the old tin hat," is coming into quite extensive use as a means of head protection against small falls of rock in mines of several states. Many of the miners [illegible] with a [illegible] the trench hat. It was argued that if, in fact, a comrade could strike the top of the tin hat a strong blow with the butt of a rifle without local injury to the wearer and no further inconvenience than the sudden vision of a few stars and a seemingly telescoped neck, then the accidental fall of a [illegible]-pound piece of ore, a frequent occurrence in the mines which may seriously wound or kill the miner, would do no damage to him. One mining company was so impressed that it gave out a large number to its miners.

The Diamond Core Drill has been used for prospecting coal and mineral lands for the past fifty years, yet it is only about three years since it was "discovered" by the oil field It has been demonstrated that the diamond drill can bore any formation which the standard or the rotary tool can bore and do it faster and at less expense under most conditions The cores secured by the diamond drilling process give the engineer and geologist accurate knowledge of the formations penetrated and of the thickness, porosity and oil content of the sand when these are penetrated —*Mine and Quarry* 13:1, pp 1282-8.

Railways

An Improved Type of Milk Transportation Car has recently been put into operation on a railway line running into Chicago These cars are of the refrigerating type with ice bunkers at either end and are equipped with two 3000-gallon seamless one-piece glass-enameled tanks. Each container is lighted by electricity and is equipped with an indicating contents gage a recording thermometer and a propeller agitator driven by an electric motor Inlets and outlets are made through the side of the cars so that the filling is possible without opening the doors Soon after their arrival in the city the auxiliary brine cooling device is put into operation and brings the temperature of the milk down to 20 The agitator is operated to restore the balance of the milk constituents before the milk is emptied to be pasteurized and bottled for delivery Immediately after emptying the tanks are washed with a soda solution rinsed with cold water and sterilized with live steam They are then sealed—*Railway Review*, 73 2 pp 61-5.

A New Type of Pullman Sleeping Car designed with a view to increasing the privacy of the sections when the cars are made up for the day has been constructed by the Pullman Company In these cars, of which over thirty have been built, the permanent part of the headboard between sections has been extended from the side of the car to within about eight inches of the passageway up as far as the ceiling In addition the headboard is completed for night use by sliding out flush with the ends of the seat a section or panel which telescopes inside the permanent partition —*Railway Mechanical Engineer* 97 8, p 572

Locomotive Feed Water Heating has been more rapidly developed abroad than in America, due largely to the economic pressure of higher fuel costs and the more open minded attitude of European railroad officials toward innovations. The Austrian National Railways now have seven locomotives equipped with a new type of feed water heater of the waste gas type. The design of these heaters consists principally of straight tubes between heaters located on opposite sides of the smokebox. This arrangement provides for a large tubular surface area extending across the path of the waste gases. The feed water is required to make six passes through the heater and this serves to raise it to 212 degrees Fahrenheit Tests which were conducted with a dynamometer-car show that the saving in fuel resulting from the operation of the feed water heater ranges from 12 to 20 per cent and that the locomotive boiler efficiency can be greatly increased by an apparatus designed to raise the temperature of the feed water by reclaiming heat from the waste gases of combustion. Moreover the operation of the locomotive is further improved by reducing the temperature and hence the volume of the gases exhausted from the stack.—*Railway Review*, 73 3 pp 96-102.

The Lift or Poppet Valve for Locomotives has not been looked upon with favor by mechanical officials of American railways, but their use is growing rapidly abroad. It is generally recognized that both slide and piston valves actuated by the Walschaerts or similar valve motion do not give as quick

an opening or closure as might be desired. Moreover, the area of this opening is too restricted. Consequently the valve ports tend to throttle the steam to such an extent that full boiler pressure cannot be realised in the cylinders. European designers have, therefore, been impressed with the possibility of improving steam distribution in the cylinder by means of the lift type of valve. The latest and most practical piston valve mechanism designed to improve steam distribution in the locomotive cylinder is found in the Pilliod sleeve valve which has recently been fitted for the first time to a locomotive of modern proportions. It was found that this type of valve enabled a locomotive to perform the same amount of work with less steam, because it is used more expansively than in the case of the ordinary type of piston or slide valve. This valve mechanism, consisting of an ordinary piston valve and two sleeves, enables the locomotive to approximate the conditions found in the best Corliss engine practice and it is reasonable to look for a really fundamental improvement in locomotive operation through its use.—*Railway Review*, 72:24, pp. 968-92, and 73 7, pp 225-33.

Shipping

Thirteen Years Afloat without Drydocking is the record of the British steel training ship "Exmouth" which was recently docked and graved at Tilbury. Her comparative immunity from rust is attributed to the fact that when she was first launched no paint had been applied to her hull and she lay in the water for some weeks while being fitted up. During this time the sea water had an opportunity to destroy the millscale on her plates, which is the secret of the record period during which she did not have to be graved. After being afloat a few weeks she was drydocked and her bottom was cleaned with wire brushes and fresh water and was painted. It is considered that the formation of the millscale during the process of manufacture of steel plates is the cause of serious corrosion. This millscale is formed, to a large extent, by the sand which is thrown on the plates during the process of rolling in order to enable the rolls to take a proper grip. Six months after going to sea, owing to vibration and to expansion and contraction, about half of this millscale has fallen off, taking the paint with it. The vessel is then placed in drydock, superficially scraped and repainted. In many places, however, rust cones have formed and the result is that paint is applied over rust, and the rust spreads under the paint. It is now being advocated that ships be launched without paint, so that the millscale can be done away with for good and all.—*Shipbuilding and Shipping Record*, 22.5, pp. 182-3.

Miscellaneous

Be Careful of Asking for Telegrams Collect.—A mayor of a Pacific Coast city recently dedicated a radio broadcasting station and he was so pleased with the sensation that he asked everybody to send him telegrams collect so he could see how his voice carried. He began to find out by midnight when he had received replies—collect—from every state in the union as well as from Honolulu. He received a wireless from a ship 1000 miles out at sea. His voice upset his bank account about $8000.

The Post Office Department Locksmiths.—The postal laws and regulations forbid *postmasters or other postal employes to repair locks*, themselves, and as a result 18,000 were sent during the year to the mail equipment shops in Washington to be repaired. The average cost of repairing each lock amounted to about six and a half dollars. Figures just compiled show that the Post Office Department manufactured 350,152 locks during 1922 at a cost of $79,000. In 1921 the number of locks turned out for the use of the postal system was 136,938, the cost being $47,500. According to these figures, 213,214 more locks were manufactured in 1922 than in 1921.

Pencil Pigments in Writing.—In a recent issue of *Discovery* Mr C. Ainsworth Mitchell discusses the question of the identification of pencil pigments in writing. He shows that the microscopical appearance of lead and its alloys is quite distinct from that of graphite, the lines showing a disconnected series of patches irregularly distributed, uniformly and brilliantly lit up, and each patch is marked with regular vertical striations. Writing in different pencil pigments may sometimes be differentiated by chemical tests. For example, the graphite and clay used for the pigment frequently contain very varying amounts of iron or of chlorides, and

the markings with them show reactions of different intensities when tested with the respective reagents. Titanium is also a com mon constituent of natural graphites, but seldom sufficient to give a distinct reaction in the markings on paper In that case, however a color test alone was sufficient to distinguish the marks made with that pencil as compared with others examined.

Freak Laurels.—The United States is generally credited with the bulk of freak enterprises and ideas, but at last we seem to be likely to be relieved of some of this notice Paris has a paper devoted to the interests of servants It is appropriately called *L Escalier de Service* or Back Stairs periodical. It is filled with the doings of servants and prints stories about butlers, cooks parlormaids, etc. Its subscription list was 6000 when the first number was issued Janitors in Paris are a powerful class as is witnessed by their union and their rules for tenants. They also have a house organ but it is of more limited appeal than the one cited

Rubber Pavement.—An experimental stretch of r a lway in Borough High Street, Southwark has been covered with a new type of rubber block the upper half inch consisting of resilient rubber and the remainder of hard rubber The two grades of rubber are vulcanized together forming a homogeneous block.

Lost, a Railroad!—A supplementary railroad built during the war to supply troops near Amiens with food and ammunition has disappeared having been stolen piecemeal It is thought that alien workers in the devastated area appropriated the property and sold it.

Sixty Mile Ski Slide Opened — The longest ski slide in the world extending over sixty miles has been opened in Sweden The course is laid out on an old road winding through the hills of a beautiful forest.

Europe s Coffee Consumption. — Europe s coffee cups were filled with the infusion of 1 180 048 000 pounds of coffee in 1922

Newspaper Baffles Newsboys. — The newspaper with the longest name in the world at least in the English language is the *Farnham H slemere and Hindhead Herald, Alton Mail Bordon and Longmoor Journal, Liphook and Liss News and North Sussex Advertiser* It is a weekly publication and can be taken home for two cents.

Keep Your Windshield Clear —The following formula has been found useful in keeping the windshield clear in wet weather One dram of sodium chloride (common salt) one ounce of water and two ounces of glycerine Place a little of this solution on a piece of gauze and wipe over the glass in a thin layer using a downward stroke

A Hotel for Dogs.—Hotel proprietors are not very keen on entertaining the canine companions of their guests and constant squabbles result when visitors attempt to smuggle in and feed their pets. Accordingly Los Angeles is to be favored with a hotel for dogs which will cater to the tourist trade by offering rooms with or without' bath Probably most of the dogs if they could speak would engage accommodations without bath. The dogs will be well taken care of while their mistresses are shopping or posing under the studio lights

Mercury in Japan.—A rich vein of mercury ore believed to extend for more than seven miles on the surface and to vary in width from two to six feet has been discovered near the village of Kita Uonoura in the upper Goto Archipelago of Japan the Department of Commerce hears. Assays show the ore to be very rich containing 18 per cent of mercury and preliminary excavations indicate that the vein increases in thickness the deeper it is followed It should make Japan independent of the rest of the world for its supply of mercury

Ski Planing.—This is a new sport which has been brought out by Lawrence Sperry the clever son of Elmer Sperry The ski plane is a winter version of the aqua plane except that one uses an airplane and a pair of skis instead of a motor boat and water sled. Sperry succeeded in holding his airplane as low as five feet above the earth as he sped along the course, but was forced to rise higher when approaching a grove. The skiers would release their hold on the ropes tied to the wings and tail skid of the plane as they approached the trees. To demonstrate the unusual qualities of the small plane Sperry went down the side of a forty-foot embankment, almost perpendicular without turning over The machine was outfitted with skids during the demonstration.

The Service of the Chemist

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Artificial Wood.—A Norwegian scientist has succeeded in making a new kind of artificial wood A mixture of sawdust with chalk and chemicals is used for this purpose. The wood contains about 50 per cent sawdust. The mixture is subjected to high pressure, and a product is thus obtained which possesses all the qualities of genuine timber The specific gravity of the wood is the same as that of real wood its hardness is like that of the oak. It can be planed, sawed, bored nailed painted, stained or polished and subjected to every process of carpentry or manufacture for which real wood is used. It will not deteriorate in water and on account of the chemicals that it contains it is impervious to rot and burns only at a temperature very much higher than that at which real timber ignites.

New Paper-Making Materials —Various new materials have been tested by the Imperial Institute regarding their availability as paper-making stock, and these tests have been reported in the Bulletin of the Imperial Institute volume XX, number 3. There are mentioned talipot palm leaf stalks betel nut husks and elephant grass The palm leaf stalks have been found to be a promising paper-making stock as they furnish a fairly good yield of pulp The unbleached pulp yields a strong brown wrapping paper and fairly white paper can be made possessing good strength but the pulp bleaches with difficulty requiring a large amount of bleaching powder The tests made with betel nut husks showed that this material was not very suitable for paper making It can only be employed in conjunction with long fiber materials for producing low grade brown papers or boards. Good tests were obtained with the elephant grass.

Wood for Lead Pencils.—Florida cedar wood is generally used in the manufacture of lead pencils But there are other woods which can be used for this purpose as well provided they are given prior treatment to soften them up properly The Badische Anilin und Soda Fabrik has been granted a patent (See British Patent No. 195 497) on a process for softening alder lime and other woods to render them suitable as substitutes for Florida cedar wood in pencil manufacture. The wood is treated under high pressure, for example about 100 to 1,500 pounds per square inch with aqueous solutions of soaps (other than resin soaps) or soap-like compounds, such as fatty acid sulfonates, with or without the addition of dissolved or emulsified waxes or fatty material, and dyestuffs, such as cedar brown GR. The treatment is effected at or slightly above room temperature.

Potash Discovery.—The London *Times* reports that extensive potash deposits have been discovered at Klein Kuhren on the Elb near Dannenberg in Hanover during test borings for petroleum Below the potash deposits oil has been found as well but not in appreciable quantities.

Sulfuric Acid and Caustic Soda from Sodium Sulfate.—In the Journal of the *Society of Chemical Industry* June 8 1923 pages 251T to 252T there is given a description of an investigation made to determine the conditions under which caustic soda and sulfuric acid could be produced from sodium sulfate. The process developed is electro-chemical in nature. A 40 per cent aqueous solution of sodium sulfate is used in the process.

Sulfate of Lead in the Electric Furnace.—Lead sulfate is made directly from finely divided sulfide ore. The ore is fed in a regulated stream between the arcs of an electric furnace, the electrodes of which are arranged horizontally in two or more pairs. The high temperature of the arc converts the material into vapor form. The vapors pass up a shaft and meet a supply of air from a conduit in the furnace which is situated a few feet above the arcs. The hot suspended particles in the vapor are converted into lead sulfate. This is washed from the fumes by steam jets or water sprays into settling vats. Acid may be added thereto in the proper quantities in order to convert the remaining oxides and sulfate of lead into lead sulfate For further details the reader is referred to British Patent No 189 160.

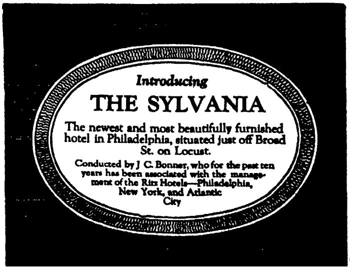
New Indigo Dyestuffs.—The dyestuffs of the dimethyl indigo series have not been used very considerably up to the present time, due to the fact that they produce dull colors on cotton and wool However a new process has been developed of changing the chemical properties of these dyestuffs by the introduction of halogen groups resulting in a product which is a dye both for cotton and wool. The dyestuffs give bluish shades which are fast to light and washing The woolen cloth is dyed in the darkest shades in one dip the tints being comparable in sharpness with those of the finest acid dyes The shades produced on cotton cloth are in many ways superior to those obtained with other dyestuffs of the indigo series The reader is referred to United States Patent No 1 412 038 and the Color Trade Journal for further information on this subject.

Casein for Making Coated Paper.—In an article appearing in the French paper journal *Papeterie* it is stated that though casein gives fairly good results it is not as satisfactory as gelatine as it is more prone to putrefaction and must be prepared within a relatively short time before use less than forty eight hours in the summer time The addition of formaldehyde as a preservative has the disadvantage of thickening it and prevents it from working properly It has been found that borax and ammonia, 10 per cent of either are the most satisfactory solvents. For many purposes borax is preferred to ammonia But when casein is to be mixed with substances having an acid reaction it is well to add a slight excess of ammonia to prevent the casein from thickening Foaming in the sizing tub can very readily be prevented by the addition of a little milk or oil of turpentine to the coating solution or by allowing amyl acetate to drop slowly on the surface of the solution

New Drying Process—A new drying process has been developed in Germany which consists in spraying the liquid into the drying chamber by means of a horizontal rotating disk. This makes it possible to handle many substances which could not be processed by spraying because of clogging of the spray nozzle The speed of the disk can be made so great that substances which cannot be dried in any other manner can be dried in this apparatus The dryer has been used in the manufacture of powdered milk and is claimed to give a very excellent product. It has been used in the drying of colloidal solutions, extracts of drugs, active principles of glands, dyewood extracts, food solutions of all sorts, glue gelatine, etc. For further details, see *Zeitschrift fuer angewandte Chemie*, 35 pages 535-6.

Metal Linings by the Spray Process.—The spraying of molten metal on to surfaces in order to produce metallic coverings is no new process, and yet it has not been completely successful in the past. The covering obtained heretofore possessed a somewhat porous texture an undesirable quality in resistant linings for chemical apparatus. Now however it is claimed by the Metal Heator A. G that thoroughly satisfactory tin, lead aluminum and copper linings can be produced on iron by subjecting the sprayed metal coat to a finishing process, which may be either mechanical or chemical or both The lining may be rendered more coherent by hammering. Or the pores may be filled up with some chemically resistant material, for example, in the case of a lead lining, with lead sulfate obtained by treating the lining with sulfuric acid The great advantage of these sprayed linings over the usual laid-on ones lies in their close contact with the substratum, an important factor in apparatus with walls through which heat is to be transferred.—*Jour Soc Chem Ind.* 1923, 327-8.

New Enamel Process.—According to the *Oil, Paint and Drug Reporter*, the Piron



Carneristi process of low temperature distillation, which has been installed in the plant of the Ford Motor Co., promises a higher yield of benzol than has hitherto been possible. This process will extract from one ton of coal ten gallons of benzol, twenty gallons of tar, ammonia equivalent to twenty pounds of ammonium sulfate and three gallons of creosote oil, besides coke and gas.

Tensile Strength of Cotton Yarn.—Unbleached and unsized warp yarn, treated with various water-proofing materials, was tested to determine its tensile strength and then exposed to the weather. At the end of one year the treated yarn was stronger than the untreated yarn similarly exposed but weaker than the treated yarn before being exposed. Yarn subjected to three treatments containing asphalt showed no material loss in tensile strength after being exposed. Raw drying oils caused more deterioration than the same oils previously boiled with metallic driers. In most cases semi-drying and non-drying oils caused as much deterioration as raw drying oils. The addition of burnt umber to a drying oil-treatment had a decided preservatible effect. Published in *Jour. Ind. Eng Chem.*, 15, 236.

Prevention of Food Poisoning.—The following practical summary of the precautions necessary to avoid food poisoning appeared in an article published in the *American Food Jour* 17, page 15. Food to be eaten raw should be fresh, clean, sound and free from stale odors, from slimy rotting areas, from discoloration and mold. It should be carefully washed in an abundance of clean water Sound food freshly cooked does not cause food poisoning. Moist or soft cooked food if held for more than a few hours should be kept in a good refrigerator If such refrigeration is impossible the food should be recooked before serving even if it does not shown any signs of spoiling. The frequency of enteric outbreaks and of botulism clearly points to a very general failure to appreciate the dangers of bacterially contaminated foods. Detailed suggestions for the inspection of canned foods are offered in connection with the campaign against botulism.

More Gasoline from Petroleum.—More and more gasoline is being produced from petroleum due to the installation of cracking processes, which break down the higher boiling point fractions into hydrocarbons which are generally found in that fraction known as gasoline. A new German process, recently developed by a chemist of the Badische Anilin und Soda Fabrik, is said to yield 75 per cent gasoline from petroleum. It is known as the Mutol process and is claimed to be superior in many ways to the various cracking processes now in use. It is said that 5 to 10 ton units can be managed by one man.—*Oil, Paint and Drug Reporter*, June 4, 1923.

New Varnish Gum from Mexico.—The Department of Commerce reports the fact that a resin can be obtained from the cuapinole tree of tropical Mexico. This resin can be used in the manufacture of the finest varnishes. One of the features of the new resin is that it is not soluble in alcohol or gasoline, as the case with the majority of similar products, and can only be refined or dissolved by a process of melting. It is pointed out that Mexico has been the producer of numerous resins suitable for making plain and fine varnishes, and adds that the cuapinole resin is believed superior to any of them.

New Fuel for Motors.—A new fuel for motor engines and internal combustion engines of various kinds has been announced under the name of ethyl gas. In the investigation, which lasted several years, to discover the ideal fuel various features of the combustion of a fuel in the motor cylinder were studied. One of the things that were studied was the knock in the engine, which was generally ascribed to ignition on the wrong side of dead center, or that red hot carbon points ignited the fuel charge before the spark could, or that there was auto-ignition These theories were disproved, and it was found that what caused the noise was a high pressure, high velocity gas wave striking the side of the combustion chamber or the top of the piston. This high pressure wave has been known to cause considerable damage, sometimes breaking spark plugs and even wrecking an engine. The new fuel will be brought out on the market within a short time.—*Oil, Paint and Drug Reporter*, June 11, 1923.

Paper from Flax Straw.—Immense

year in the Canadian prairie provinces, and attempts have been made during past years to find a use for this product which ordinarily goes to waste. It is estimated that there are each year over a million tons of this straw available after the seed has been recovered by threshing. The straw has been burnt each year in order to clean the land for future farming operations. The research work that has been carried out to find a new use for this material was conducted under the auspices of the Canadian Pacific Railway and the Honorary Council for Scientific and Industrial Research.

The straw was known to have a certain value for its fiber, being in this respect similar though of inferior grade to the straw cultivated for the production of fiber flax. The threshing process, however, had the effect of destroying the fiber value of the linseed flax straw, even for the production of the commercial tow, owing to the way in which the straw is broken up in the threshing. This suggested the possible use of the straw for the manufacture of paper pulp. The scientific details for making a high grade writing paper from this raw material were worked out to perfection, but unfortunately the cost of the process was too high to make it possible to use the same on a commercial scale. Accordingly, investigations were carried out to determine the feasibility of manufacturing cheap newsprint from this stock. Definite results have not yet been published.

A recent improvement in the machinery used to extract the seeds renders it possible to perform this operation in such a manner that the fiber value of the straw is not destroyed Hence there is now possible the use of the fiber in manufacturing the lower grades of linen cloth. A process has also been worked out for using the flax straw in the manufacture of a heat insulating material. The resulting product is an efficient non-conductor of heat and cold, and is being used with success as linings between walls and under roofs. Flax straw can also be used to good advantage in the manufacture of tow for upholstering.

Carbon Black by Electrical Cracking.—There is a great deal of current legislation in the various states against the present method of producing carbon black by the incomplete combustion of natural gas. This coupled with the increasing demand for natural gas for other purposes indicates that the supply of carbon black will be gradually reduced and that new methods will have to be found for its manufacture, so as to utilize the carbon that is in the natural gas to better advantage. The Bureau of Mines has been making extensive investigations on this important subject, which are reported in Serial No. 2417.

It was observed in these investigations, when discharging electricity through the gas under certain definite conditions, that the natural gas could be decomposed and that carbon black could be produced. Various types of electric discharges have been studied to determine the underlying factors and their possible effect on the yield of carbon black.

Present commercial plants using natural gas for the manufacture of carbon black, recover from 0.8 to 1.5 pounds of carbon black per thousand feet of gas consumed. This is less than 5 per cent of the carbon in the gas. In the present methods the gas is heated to incandescence by burning it as a luminous flame, and therefore a considerable quantity of the gas is consumed as a source of heat. A greater yield of carbon per thousand cubic feet of gas can be expected when the heat is supplied from some external source or by using the energy that is inherent to the gas in a more effective manner to bring about decomposition of the same.

Chemicals from Granite.—Granite consists principally of the mineral feldspar, which is known to have a high content of potash, alumina and silica. A new process for recovering these constituents from granite is described in the *Raw Materials Review*. The process is known as the Brown process and is of special interest in that it permits the recovery of all three of the ingredients in a marketable form. The process consists in the application of acid gases to finely ground feldspar, in a rotary kiln, at low temperature. The disintegration is continuous and complete, and the finished products are obtained by leaching and crystallization.

By means of the Brown process the 17 to 20 per cent of alumina contained in potash-feldspar can be converted either into sulfate of alumina or partly into the com-

partly or wholly into commercially pure alumina. In the latter form it would require less than half the quantity to make one pound of the metal aluminum, than in the case of bauxite used for the same purpose.

Basic Slag As a Fertiliser.—The chief compounds in basic slag are apatite, a mixture of calcium fluoride and tricalcium phosphate, dicalcium silicate, aluminates, ferrites, and oxides of ferrous iron and manganese in the free state. Low grade basic slags, obtained in the open hearth process of steel manufacture, were tested to determine their fitness for fertilising purposes. It was found that this type of basic slag possesses a distinct value as a fertiliser It was also concluded from the fertilising experiments that the finer the sub-division of the slag, the better fertiliser it made.—*Jour Soc. Chem Ind.*

Cream of Milk Sugar from Larchwood.—Montana larch is being treated for the production of cream of milk sugar Cream of milk sugar or mucic acid is a product of the sugar galactose. It is extracted in its complex form, then hydrolysed and oxidized to the acid derivative The product is pure white and crystalline. It contains no impurities such as metallic salts. It has a taste similar to citric acid or tartaric acid and does not deteriorate on standing. It is employed in the manufacture of foodstuffs, soft drinks, jellies, jams, ice creams, candy, medicine, etc. It is also used in the mordanting of cloth preparatory to dyeing and printing. It is also used to a large extent in the baking of bread, either for straight baking acid or for manufacturing self raising flour or baking powder It has approximately twice the working strength of cream of tartar Oxalic acid is recovered as a by product in this process.—*Raw Materials Review*

Removing Sulfur from Gas.—According to Swedish Patent No. 51,536, this is done by mixing the gas with a suitable amount of acid in one form or another and then introducing the mixture into a chamber or a series of pipes. In this apparatus the mixture is heated to a temperature high enough to decompose the sulfuretted hydrogen, present in the gas, to sulfur dioxide and free sulfur Then the gas is passed through another apparatus in which a reducing action takes place whereby the sulfur dioxide is decomposed to free sulfur.

Churning Temperature.—Many floating dairy thermometers indicate 62 degrees F as churning temperatures. In the old days, when whole milk was churned, this may not have been far out, but separated or skimmed cream seldom calls for so high a mark. Requirements vary according to several factors, among them, as an English expert points out, the thickness of the cream, its degree of ripeness, the temperature of the air, the breed of the cow, and even feeding and period of lactation. Authorities in dairying state that the range is from 45 to 62 degrees F, the higher point being used only in very cold weather Manufacturers who indicate the 62-degree temperature on their thermometers do not seem to know why they do so, except that it has been the custom for many years.

The Tanning of Fish Skins.—A Norwegian has patented a process whereby fish skins are salted and limed in a dilute solution softened with soda, the strength being progressively increased by additions of milk of lime, after rinsing, and sometimes puering, they are submitted to the action of a vegetable or chemical tanning agent only slightly acid or neutralised. For chrome tanning the skins are puered, treated in a solution of sodium chloride to which hydrochloride acid is added in increasing quantities, soaked in soft water, and tanned in pure chromate in gradually increasing quantities. After washing they are treated with sodium thiosulfate or soda, and freed from acid by means of tepid water and chalk.

Beware of Fake "Booze" Powders.—In our mail frequently come advertisements, generally from the foreign wine-growing districts, offering "dehydrated" alcoholic beverages in powdered form, usually for "one dollar only," in American currency. This is significant, as the Post Office authorities are constantly issuing fraud orders and returning money orders. If these powders really contained alcohol they would be seized, and as they do not have the latent possibilities of cheer, they come under the mail fraud statutes.

Radio Notes

Wired Wireless Communication.—A publication giving an introduction to wired wireless or line radio communication has recently been prepared under the direction of the chief signal officer with the cooperation of the Bureau of Standards. This pamphlet gives an explanation of how messages are carried to distant points by radio-frequency currents directed over wires such as ordinary telephone lines or power lines. The fundamental principles of radio and its relations to line radio telegraphy and telephony are also discussed. This pamphlet is "Introduction to Line Radio Communication," Signal Corps Radio Communication Pamphlet No. 41, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Radio Dramas have been broadcasted by the WGY station of the General Electric Company at Schenectady for nearly a year During that period the little group of WGY Players has had the largest audiences ever before accorded dramatic offerings. There are at least 2,000,000 radio sets in the country, and of that number 1,500,000 are almost nightly within range of WGY From the very first the radio drama has been a success. Mr Edward H. Smith, formerly an actor and director on the professional stage, has been handling this feature of the WGY programs Mr Smith and his players have pioneered in the art of the radio drama, they have had to develop a new technique. It has been found necessary to make occasional changes in play manuscripts, especially where a climax depended upon sight for its appreciation. The entrance to or departure from a room by one of the characters has to be indicated by sound, as a closing door A bell helps somewhat in announcing a newcomer to the invisible stage Various sound devices have been created to produce atmosphere. A telegraph key and an imitation of an engine whistle have helped in a railway station scene. Storms have been stimulated by devices similar to those used on the stage.

The Acoustics of Loud Speakers are discussed, among other things, by Mr Nyman in the *Journal* of the American Institute of Electrical Engineers. "Speech and music are both modified considerably, depending upon the length and shape of the horn, also on the volume of the sound," states this authority "A horn longer than one-quarter wave length of the lowest pitch available gives the best reproduction. However, in practice the length of the horn seldom exceeds three feet, approximately one-fourth of the wave length of 90 cycles, the fundamental of the horn If the horn is shorter than one foot (270 cycles fundamental) the bass and baritone voices are likely to be distorted, since their fundamental, which is below 270 cycles, would be reduced. It has been found that a loud speaker with a magnetic balance and a horn about two feet long is capable of very good reproduction of even very low frequencies. Careful study has been made of materials to be used in diaphragm and in the horns in so far as it affects the quality of reproduction. Aluminum or micarta diaphragms apparently give the best results, while a wood horn or horn made of some 'dead' material like hard rubber is least likely to introduce a strange quality"

Our Japanese Radio Link.—The radio telegraph circuit between the United States and Japan is operated continuously, carrying a large portion of the trans-Pacific telegraph traffic. When the recent disastrous earthquake devastated Tokio and Yokohama the radio service was not interrupted. The first news of the disaster came to the United States over this radio circuit, and for several days thereafter the most complete dispatches describing the extent of the losses and damage came via the Radio Corporation service. There are several Japanese stations working with America. First, there is the Iwaki radio system, owned and operated by the Japanese Government, comprising a transmitting station at Haranomachi and a receiving station at Tomioka. The general location of these stations was determined by the comparative freedom of the district from seismic disturbances. The transmitting aerial at Haranomachi is of the umbrella type, supported by a self-supporting central tower and an outer ring of 18 spliced, guyed wooden masts at a radius of 1800 feet. The central tower is a reinforced concrete tube 660 feet high, 57 feet in outside diameter at the base and 14 feet outside diameter at the top. The wooden masts in the outer ring are 250 feet high and consist of three sections.

Radio Notes

British Empire Wireless Plans.—Recent statements of the British Postmaster General indicate that a solution has been found to the problems connected with the establishment of the British Empire wireless chain. Not all points connected with the issuance of wireless licenses have been disposed of, but there is every indication that the Government has adopted a policy which will permit private radio companies to establish high-power stations both in the United Kingdom and in the colonies. At the same time the post office will proceed with its own plans for a high power station in England. The new post office station will be located near Rugby, a site with an area of 800 acres.

High-Power Radio Station for Belgrade.—Work has been started on a new 100-kilowatt radio station at Rakovica, about four kilometers from the Serbian capital, and on a receiving station at Laudon Trench, a suburb of that city The station is being built by the French Wireless Telegraph Company and the total expense is estimated at about $402,800. On its completion the entire installation will be taken over by the State. The operating personnel will become employees of the Department of Posts and Telegraphs, the company maintaining one engineer as a technical adviser. This particular station will be the first high-power radio installation in the Balkans, and because of the greatly increased facilities which it will afford for the dissemination of news and the rapid dispatch of information, it should soon become well known internationally

Increasing Interference from Spark Stations is being noted by radiophone listeners, especially in the New York area. Evening after evening the spark stations break into the excellent musical programs of the broadcasters and mess things up for the listeners. During the most exciting moments of the short but thrilling Dempsey-Firpo bout, the spark stations broke in with the most aggravating racket. The writer of these lines has listened to spark stations sending the test letter, "V," minute after minute during the height of the evening broadcasting entertainment. Of course, the stock excuse on the part of spark operators is that broadcasters are either using inefficient receiving apparatus, which cannot be tuned sharply enough to eliminate undesired waves, or that the broadcasters lack the necessary skill to tune properly—or most likely both. To which we hasten to reply that even with the sharpest kind of tuners, such as the Reinartz circuit, we have time and again been unable to eliminate the intense interference from spark stations. Obviously, the radio inspectors have a job ahead of them. The majority rules, does it not?

New Ideas for Grounds.—Three methods have been introduced during recent years with a view to minimizing ground losses, namely, the multiple antenna of Alexanderson, which is employed at Radio Central, the powerful multiple transmitter station of the Radio Corporation of America; the ground screen installed at several of the Marconi stations, and the multiple ground system in use at Sainte-Assise and being installed at Nauen. The first-named is applicable to very long aerials at a medium height, and especially to those of the T or inverted L type. It really reduces it to a number of smaller aerials connected in parallel and the paths of the ground currents are greatly reduced. The ground system of each one of the multiple aerials has still to be properly designed and may involve either of the other methods. The ground screen is a development of the insulated counterpoise, the wires being so spaced and arranged that they practically screen the ground from the electric field of the aerial. The introduction of the ground screen has reduced the ground resistance of the stations where it has been installed to a fraction of the previous value, with a corresponding increase in the efficiency The multiple ground system, on the other hand, consists in distributing under the aerial a large number of ground plates or pins, the currents from which are brought back to the transmitter station by means of overhead wires. The French engineers at Sainte-Assise have fitted up both types, so as to compare the relative merits of the ground screen and the multiple ground system. It appears that they have decided on the latter, the reasons being given that the ground screen is expensive and that the large number of wires with their supports and insulators make it difficult to carry out work on the aerial. They consider that equally good results can be obtained by the multiple ground system.

The Drama of Disputed Documents

(Continued from page 308)

rapidly building up his credits with jobbers by sending in orders which constantly grew in volume. In each case he paid on the day required and also sent along a fresh and bigger order. After he had got the jobbers and manufacturers convinced that he was "good pay" and had a business that was expanding, the swindler invariably sent in the biggest order of all, three or four times as large as any preceding bill. Then he packed the goods, shipped them to some secret place of concealment and vanished. Mr West got hold of the letters which this man had written to his various creditors and found in them the same peculiarities which existed in much earlier letters written by the notorious Gashie Stein. For one thing, Stein had the habit of typing out the day and date in full, thus: February Eighteenth, Nineteen Twenty-three. He was also deficient in commas and connective punctuation. He invariably wrote Yours Truly with a capital T There could be no doubt. Besides, all the letters were obviously written on an old machine which Stein had carried about with him for years on his peregrine. He was eventually run down and the evidence of the letters convicted him.

The reader will find on these pages some samples of typewriting as submitted to a Congressional investigating committee by Mr Carvalho some years ago. There had been a hot fight over the kind of submarine to be adopted and the appropriations to be allowed for their building. In the course of the contention two communications, both anonymous, had been sent out into the district of a Congressman who adhered to one of the inimical parties. Complaint was made that another Congressman had sent out these communications for the express purpose of slandering and defeating the other man In order to establish this point, the original communications were examined and Mr. Carvalho reached the conclusion that they had been written on one and the same machine. He indicated its make and model. Search revealed that there was such a machine in the office of the accused Congressman and samples of writing from this typewriter were obtained. Carvalho then enlarged the originals and the samples. Next he juxtaposed words appearing in the originals and the other writing from the suspected machine. In this way he demonstrated, by means of the juxtaposed enlargements, that all the writing had been done on the typewriter in question and that the campaign of slander was either done by or with the probable knowledge of the accused member.

Questions of handwriting often play vital parts in the destinies of great families, where corrupt lawyers, scheming adventurers or criminals of even darker dye find some method of gaining a profit out of falsification. No more sensational case of this kind ever came into the courts than that which involved the legitimacy of all the children of the financier, Jay Gould. This case was tried in New York State in 1899.

A woman named Margaret E. Cody wrote a letter to George J. Gould in that year, stating that she had the evidence to prove that his father had married a Mrs. Angel in 1853, that a child of this union survived, that Jay Gould and Mrs. Angel had never been divorced and that the Gould children were, accordingly, illegitimate and not entitled to their enormous inheritances. A baptismal certificate and marriage papers figured in the case, as did an entry on the record book of a small church upstate. (Marriage licenses were unknown in 1853.)

The affair was, of course, full of sensational possibilities and gained immediate and enormous notoriety. The idea that all the members of one of America's richest families might suddenly be reduced to the status of illegitimacy and deprived of their riches was an all too honeyed morsel for the tongues of gossip.

Two criminal trials resulted. At the first there was a disagreement. But Mrs. Cody was again haled before a jury and it was shown, by means of expert testimony, that the ink of the church record was new, that the page showed erasures, that the signature was not that of Jay Gould and that forgery had been committed on all sides. Mrs. Cody was convicted and eventually admitted part of her responsibility for the plot.

Wills are and perhaps always will be the favorite target of the falsifier. Every year sees many surrogate trials in which the last testaments of wealthy men are attacked and figured into the hands of experts for opinions as to their authenticity. The fact that the makers of wills cannot raise their voices out of tombs and denounce the guilty seems to lead many falsifiers into this line of fraud and heartless deception. However, it is the extreme rarity for such forgeries to go undetected and such schemes to succeed.

No more striking case of a subtle attempt to profit by an altered will can be cited than that which had to do with the last testament of George P Gordon, the rich inventor of the printing press which bears his name Mr Gordon died in 1878 at his home in Orange, N J., and left a will which was ambiguous. The heirs accordingly made an agreement among themselves for the partition of the dead man's property and this compromise was approved by the court.

But before the formalities could be concluded there appeared upon the scene one Henry Adams, a retired obscure lawyer, who owned a farm near Rahway, N J., adjoining a much larger property on which George P Gordon had formerly made his home It was known that about the year 1868 Gordon had lived on his Rahway place and been on friendly terms with Adams and his relatives. It was also known at the time that Gordon had considered buying the Adams farm for the purpose of enlarging his holdings. But he had subsequently moved away to Orange and the purchase had never been made. No doubt the inventor had changed his mind about it.

Now, however, came Henry Adams with a hand-written (of course) draft of a will which, he said, had been drawn by him for Gordon, at the latter's request, in 1868. The draft which Adams presented to the court was, by his own statement, an original rough draft and there were marked upon it many additions, alterations and emendations, all in red ink. Adams said that a clean copy, embracing the red ink changes had then been made for Gordon, while he as attorney, had retained the corrected original. This bore the signatures of Gordon and those of Henry Adams as attorney and several of his relatives as witnesses. But Gordon's copy of this instrument could not be found and his heirs contested the probating of this rough draft. They suspected fraud and said Adams had a motive for presenting it, since it contained a clause by which the heirs were instructed to buy the Adams farm for $32,000 The property had never been worth that sum, it was contended. At the time of the contest, in 1879, it was shown that the farm was worth no more than $12,000. But Adams persisted, repeated that the will was genuine and insisted on the carrying out of the provision relating to his farm.

At this point the astute Dr Carvalho was summoned and asked to put the Adams copy to a thorough test. He was furnished with many samples of George P Gordon's genuine signature and with the true signatures of the Adams relatives who appeared on the will as witnesses. Carvalho examined these various signings and concluded that neither Gordon nor the relatives of Adams had ever signed or seen the paper His opinion was that Henry Adams had done all the signing himself, using the authentic copies to guide him.

But the most striking discovery was still to come Mr Carvalho noted the interlineations in the suspected will and saw that they had been written in a peculiarly brilliant red ink, having a bronzelike lustre. He went for his chemicals in considerable excitement, conducted a careful analysis of the red ink and discovered that it contained eosine.

All old fashioned red inks were compounds in which the active color ingredient was cochineal, the dyestuff extracted from a cactus infecting insect of the same name. Cochineal was the basis of most red dyes, food colors and inks until 1874 and later In that year the German chemist Caro extracted eosine from coal tar and soon used it for ink making. But the process of extraction was at first very costly and it was not until 1878 that the first eosine ink was offered in the American market. This ink was so much more brilliant, easy flowing and cheap than the old cochineal inks that it fairly leaped into popularity But Henry Adams had, by his own jactation, written the Gordon will and the red interlineations in 1868—ten years before there was a drop of eosine ink in the American market! His claim was accordingly and emphatically tossed out of court and its perpetrator arrested for forgery.

Thus reads the story of disputed documents—just another phase of the constant battle being waged between the criminal and the forces of law and order. In this instance, however, it does appear as though the forces of law and order have the best of the argument in the long run.

Earthquakes and Volcanoes

(*Continued from page 305*)

set up loosely on their foundations and so put together as to permit a certain amount of swaying. Unfortunately these safeguards against earthquakes prove an aid to fire. Consequently American builders of recently erected steel frame buildings in Tokio, which were especially constructed with a view to earthquakes, have been greatly delighted by reports that these structures have gone through the quake and fire with a fine showing, and they foresee a greater use of steel in future building in Japan.

In a seismic country, fault lines should so far as possible be avoided in the location of structures liable to damage. The Seismological Society of America has just issued a valuable map showing the location of faults in California. Special precautions should be taken in the location and construction of dams, bridges, aqueducts and water-mains; and proper provisions should be made for the prevention and extinguishing of fire

Nearly every civilised country maintains an official seismological service, established in many instances after the people had been literally shaken out of their lethargy by a great disaster. In the United States, this work is carried on by the Weather Bureau.

Volcanoes

Volcanic eruptions are to the human mind perhaps the most impressive of geological phenomena. They may be explosive, quiet, or of an intermediate type. When violently explosive, they produce, in the main, solid fragmental material and gases (largely steam) are the chief factor involved. In a quiet eruption, flows of lava (liquid rock) make up the main product. Contrary to popular belief, there is little real flame connected with a volcano. The intermittent glow seen over a volcano at night, and the columns of "flame" seen issuing during an eruption, are due to the illumination of the clouds and vapors by the incandescent lava and glowing particles of rock.

Some volcanoes are more or less continuously active, with more violent outbreaks now and then, while others are nearly or completely quiescent for long intervals between eruptions. Many of the greatest volcanic mountains of the earth appear to be completely extinct, but sometimes a supposedly extinct one breaks out into eruption In many volcanoes, during a quiescent stage, there appears to be a gradual accumulation of pressure. Lava rises in the conduit, and eventually an eruption begins explosively, great quantities of gases, mingled with dust and stones, being ejected. The pressure being thus to a great extent relieved, this phase is succeeded by a quieter one in which lava escapes through rents in the cone.

Probably there are about 400 or 500 active vents in the world at the present time, together with several thousand which are dormant or recently extinct. These have a general tendency to be grouped in long lines upon the earth's surface, following the zones of weakness along which movement and disturbance of the outer crust has taken place. The most marked of these is the veritable "circle of fire" bordering the Pacific Ocean. Most oceanic islands are volcanic.

The United States contains many interesting extinct volcanoes (Crater Lake, Oregon, occupies the crater of one), but very few have been active within continental United States (exclusive of Alaska) in historic times. Lassen Peak, Calif., has exhibited mild activity at frequent intervals since May, 1914.

Vulcanology is not so well organised nor so well advanced as seismology However, a few observatories have been established to keep regular watch on volcanic phenomena (for example, on Vesuvius and Kilauea). In a a few cases fairly accurate predictions have been made of eruptions.

Famous Volcanic Eruptions

The most frightful of all explosive eruptions is said to have been that of Asama-Yama, Japan, in 1783. However, the best-known explosion was that of Krakatoa, in the Straits of Sunda, near Java (the greatest focus of volcanic activity on the globe), in 1883. After premonitory outrushes of gas for some time, there suddenly came a series of explosions which blew away over a cubic mile of the volcano. The vast dark cloud of dust and ashes rose 17 miles into the atmosphere, completely hiding the sun over a vast area. This dust was distributed over the entire globe by the upper winds, and was responsible for red sunset glows all over the world for many months. The terrific detonations broke windows 100 miles away, sounds were heard for 3000 miles, and the air waves generated traveled several times around the earth, as barograph records revealed. Waves up to 100 feet high rushed along the low-lying coasts of Java and Sumatra, sweeping far inland, and drowning 40,000 people. In a similar explosion of Mont Pelée on the island of Martinique, 1902, heavy fiery clouds of intensely heated gases laden with incandescent particles of rock rushed down the mountain slopes to the sea, and immediately destroyed the town of St. Pierre with its 30,000 inhabitants.

Perhaps the most remarkable volcanic area on the earth is the region surrounding Mt. Katmai, Alaska, the scene of a stupendous eruption in June, 1912, which spread desolation over an enormous area and darkened the sky for miles around the volcano, leaving in its wake the great "Valley of Ten Thousand Smokes" from which steam and gases are still escaping.

Vesuvius, the most-studied and best-known volcano in the world, is of the intermediate type, being in a state of almost constant mild activity, with now and then a violent outbreak, such as that of 1906. It is famous for the eruption of 79 A. D., in which Herculaneum and Pompeii were destroyed. Stromboli, in the Mediterranean, is in the same class. The constant illumination of its overhanging cloud provides a natural lighthouse.

Our Abrams Investigation

(*Continued from page 307*)

paper labels on the typewriter. Meanwhile, another member, aided by the doctor's assistant, the aforesaid Dr Y, scraped off the hand-written, red-edged labels. The change was soon effected. Nevertheless, for some reason or other, the results were no more satisfactory than before, even though George, by "shorting" himself, indicated that he was bearing up well.

As a sort of check on Dr. X's technique, his assistant, Dr. Y, also took a hand at diagnosing. Unfortunately, Dr X and Dr. Y did not obtain the same results, as for instance on tube No. 4, for which Dr. Y found streptococcus and tetanus both present, while Dr X found neither. Dr. Y explained at this point that Dr. X, while an expert diagnostician in every way, works too fast and does not give the reagent time to return to normal in going from one "rate" to the next. She, Dr Y, is forever cautioning Dr. X on point.

In going over the tubes again, after being told what they contained, Dr. X, working slowly and with more thoroughness, did find typhoid in tube No. 1 and streptococcus in No. 2 and tetanus in No. 4. The reactions were quite positive by now

From time to time during the later part of the test, Dr X requested that those present, and especially the reagent, keep their minds off the pure germ cultures which might be in the tubes. It seems that even the thoughts of those present have a serious electronic effect on the reagent and the accuracy of the diagnosis. Sensitive—super-sensitive, these reactions!

If the process is as delicate as all this, one begins to wonder how positive and accurate the electronic reactions diagnosis can be when dealing with the complex organism of the average patient, with a wide range of ailments to be differentiated. Especially does one wonder when two practitioners do not agree in their findings when dealing with such a specific thing as a pure germ culture. These results are quite different from the positive manner in which an electronic reactions diagnosis is conducted with the usual patient, and the findings tabulated in cold black-and-white charts.

Meanwhile, Dr. Abrams has extended to us his personal co-operation. He has promised to give us demonstrations while here in New York some time in the near future, if time permits. Obviously, Dr. Abrams is the leading Abrams practitioner. He has pointed out to us the danger of drawing conclusions through tests with persons who claim to be Abrams practitioners but who are not. Incidentally, Dr. Abrams has written to us, stating that Dr X, with whom we had the test just described, does not represent E. R. A.—the genuine electronic reactions of Abrams—method. This fact must be taken into consideration, although we are beginning to wonder if this problem of getting in touch with genuine Abrams practice is not going to be an exceedingly difficult one. Dr. Abrams states that there are over forty "bogus" electronic reactions machines now on the market. All of which is highly interesting and must be duly considered.

Electrical Notes

Wire Insulation Stripper.—There is now available a wire insulation stripper which will strip 1200 ends an hour in the hands of the average worker It cuts and strips the insulation without nicking or fraying—instantaneously and automatically like a pair of pliers, as fast as the user can close his hand Anyone who has ever whittled the insulation from a wire end with a jack knife or pulled it through a scraper will appreciate this simple little hand tool

The Lighting of New York's Subway and Elevated Cars is an expensive proposition so we learn from the *Electric Railway Journal* It will cost $500 000 this year to light the subway and elevated trains, station platforms track signals and other facilities of the Interborough Rapid Transit Company of New York Of all the energy generated in its power plants 6 6 per cent will be required for electric light. There are 320 000 outlets throughout the system including those for 50 000 incandescent lamps in the subway cars and 88 000 on the subway platforms and in the tunnels Ninety per cent of the last named burn continuously The elevated trains require 45 000 lamps for lighting Track signals account for additional thousands of lamps Every 400 feet along the subway track there is a blue lamp indicating the location of an emergency switch for shutting off power in the third rail

Sockets in Instalments.—In view of the present high cost of electrical supplies, we are apt to be quite curious when we learn that electric light sockets among other electrical supplies are being sold by one of the leading 5 and 10 cent stores A study of the situation proves the truth of our source of information sockets are being sold in such stores But we also learn that the sockets are being sold not in a single unit as is the usual custom, but in instalments Thus for 10 cents we can buy the cap and the shell without the business part For another 10 cents we can buy the innards of the usual socket. Hence for 20 cents we can buy a complete electric light socket In view of the ingenious manner in which various devices are split up and sold in pieces so as to come within the hard and fast 10-cent limit, we like to speculate on how many parts will constitute a flivver when this popular article is sold in the 5 and 10 cent stores

The Progress in Electrical Illumination was strikingly brought out by Messrs J W Howell and Henry Schroeder in a paper presented at the recent annual convention of the American Institute of Electrical Engineers It was pointed out by these men that if the present 40 watt tungsten filament lamp were made for the same average efficiency as Edison's bamboo carbon lamp of 1880 the tungsten filament lamp would have a life of more than 150 000 years Taking into consideration the enormous efficiency gains in the large gas filled lamps the showing is even greater It was brought out that the 40-watt lamp is now over eight times as good as it was when first introduced sixteen years ago If we were using the old carbon filament lamp of pioneer days for our present day electric light requirements our annual costs would be increased by some three and one half billion dollars This would require about fifty million additional tons of coal or about 10 per cent of the total coal production in the United States

An Ingenious Variation in Automatic Telephones has recently come to our attention It differs from the usual automatic telephone in that the subscriber gives his number to an operator in the usual telephone system and does not have to work a dial The operator on the other hand does not have to make the connection by means of plugs and jacks Instead the operator depresses keys not unlike those of an adding machine as the exchange and the number are being given to her by the subscriber As soon as the subscriber has finished his number, so has the operator made all the necessary keyboard manipulations and the connection is made Comparative tests of this semi automatic system and the full automatic seem to disclose several advantages for the former In the case of small switchboards now in use it may become possible to replace these with automatic switchboards controlled by one or two operators some distance away in a neighboring town which has a large central office Obviously, it is more economical and efficient to maintain a large plant than a small one, and the operator need only have a few lines between her keyboard and the automatic switchboard in the crewless exchange some distance away.

Within the Atom

(Continued from page 369)

But it is surely unlikely that it is really a compound of that kind; independent helion atoms are not likely thus to hang together. The atom of nitrogen may have a structure of its own, which is not really compounded of the elements into which it may nevertheless be broken up, any more than we need say that water actually consists of hydrogen and oxygen, though it turns into those gases, and nothing else, when decomposed.

It is perhaps a question of expression. Mr Aston of Trinity College, Cambridge, has asked a corresponding and relevant question by the words, Does a pistol contain smoke? Some might say, yes, because smoke comes out of it when fired; others might say, no, the smoke is generated by the explosion and was not pre-existent. Neither statement need be false. But which is the more convenient?

Suffice it, therefore, to say that an atom of nitrogen can demonstrably be broken up into helion and hydrogen, but that what its constitution may be like before it is broken up is a question which awaits an answer

What is certain in this experiment is that atoms of hydrogen are driven out. What is uncertain is what becomes of the rest of the nucleus. If it still clung all together it would be an atom of carbon, which would be unlikely Most likely it breaks up into three atoms of helion. But other groupings can be suggested, and possibly the particular grouping may depend on circumstances. The evidence goes to show that hydrogen is certainly projected, and helion, probably But it is a great experiment, for the disintegration of a chemical element had never previously been *performed* by artificial means. I do not say that nitrogen is the only one that has been dealt with, but I take it as the type. This breaking up of an atomic nucleus is a very recent discovery

Has Sea Power Passed?

(*Continued from page 314*)

attacking planes one would need to carry enough bombs to surely sink 18 battleships. How many carriers would it take to carry that many planes, etc? Let one figure along that line and he soon sees what an expensive thing it would be to depend on Air Power alone rather than on Sea Power of which Air Power is an essential factor Remembering that even the largest planes carry but one torpedo or one large bomb, it must be evident that to carry the necessary number of such missles to the fighting area there must be an enormous number of planes. Since not many large planes can be carried by any one carrier, the number of *carriers* will have to be great and the carriers must be large ships. Under the Treaty Limiting Armaments the signatory powers cannot build many large carriers. Under the circumstances how can a very large number of large planes ever be put into a fighting area at sea?

In short when we read the extravagant claims of the air radicals, one is reminded of Lord Lee's rebuke last March to a Member of Parliament who made an extraordinary statement regarding the prowess of airplanes "Such a claim can only be described as rubbish and it is really trifling with Parliament and the country to make such statements, which are only calculated, without any excuse or justification, to undermine confidence in the Navy."

Great stress has been laid on the difference in cost between an airplane and a battleship. A fighting plane with engine costs about $18,000, a torpedo and bombing plane costs about $40,000, if we take the average cost as $30,000 and six months to build, there is an apparent advantage in favor of the airship; but it is only apparent, for the accessories which must go with aircraft, such as hangars, airplane carriers, shops, launching apparatus, flying fields, all cost many millions. Furthermore, the life of a battleship is 20 years, that of an airplane about two years. It is true that the crew of a battleship is 60 officers and 1200 men and that of a fighting plane five men, and for a scouting plane 12 men with one officer to each plane. A rough estimate for the number of men to maintain and care for 2000 airplanes would be 2500 officers and 20,000 men. There is nothing cheap about aircraft. But as Mahan says, "all this talk about the costliness of war is nonsense, except when one pays too dearly for the result, or the result is worthless."

Our Air Policy. We have none! Up to date our motto has always been "Sufficient

unto the day." We have a few air squadrons and one dirigible. Admiral Moffett, the Chief of Naval Aeronautics, says, "In spite of the fact that the nations throughout the world are turning to air power for national defense, and bending every effort to develop aviation to serve them commercially, we, in America, unfortunately seem to suffer from a general state of apathy towards this great development. In fact our neglect of aviation will soon amount to almost a national peril."

Functions of Airplanes in War as an Adjunct of Sea Power These are (a) reconnaissance, (b) spotting, (c) bombing, (d) blockading.

(a) As a scout the airplane is ideal, in clear weather. At an altitude of one mile, a large vessel can be seen 80 miles, the range of visibility varies, of course, with the size of the object and condition of the weather.

(b) With airplane spotting, fleets will hereafter go into action before sighting each other, and they will shoot accurately while each is below the visible horizon of the other At recent long-range target practice in the Pacific, the "Tennessee" opened fire at 35,000 yards (17¼ miles) and "straddled" the target on the third salvo at 32,000 yards.

(c) The restrictions of the airplane as a bomber have been described already

(d) Airplanes if operating from carriers could materially assist a strong force of submarines in establishing a commercial blockade, but it would be quite impossible to blockade a fleet if the enemy were accompanied by submarines and aircraft of his own. In the North Sea the submarine failed as a blockader, neither the Grand Fleet nor the High Seas Fleet were kept in port by them.

"*Let* no one get the idea," writes Captain Harris Laning, U S N (Staff of the Naval War College), "that aircraft have no place on the sea. They have a place, a place of vital importance, probably more important than that of any type of craft yet developed. Through them the whole scheme of getting and holding overseas lines has been changed. Possibly the developments of the future may prove that Air Power also includes Sea Power But Air Power will not and cannot lead Sea Power as long as the present treaty limiting armaments remains in effect. As long as that treaty lasts, air forces must remain merely an adjunct of Sea Power, they cannot dominate it. What Air Power may be after the treaty expires we cannot predict; but there must be a great advance in air development before it drives out the *combatant* surface ships. In fact, those who give the most attention to the air problems find that while Air Power is a factor in Sea Power, Air Power is likewise *dependent* upon Sea Power Those students who study and practice rather than dream and articulate, believe the two powers interlock and that each is a part of the other Understanding the question better, they are endeavoring to keep the national defense on a solid foundation"

At the present time, there is nothing to indicate that Sea Power has passed away and is no longer the supreme defense of the country It has, however, gained an indispensable and essential auxiliary, and linked with Air Power it will continue to endure until some remote period when Air Power alone may control the main highways of international commerce and communication Not until then will Sea Power lose its present character and importance.

Materialized Hands

(*Continued from page 317*)

to the top of the ankle The other was the mold of the lower part of the face of an adult. The upper lip can be seen, the lower lip, the depression beneath it and a bearded chin.

We examined the molds carefully; their bluish tint is exactly that of our paraffin, which I had colored a little more strongly before the experiment. Over and above this, we verified a fact which by itself would prove that the mold of a foot was certainly made in our paraffin. An excess of blue dye having been added and not entirely dissolved, there were in the tank in the lower parts of the wax some scattered crumbs of the colorant. And in the mold of the foot, at the level of the third toe, we could see one of these crumbs imbedded in the paraffin congealed above it. It was as big as the glass head of a large pin and of a deep blue color The crumb is identical with those remaining in the tank. It had, therefore, been caught by the ectoplasm dipping into the wax and been incorporated in the mold. This unforeseen and unsought proof is con-

placing. But finally, after the experiment, immediately after the séance I took small pieces from the mold of the foot, put them in a test-tube and dissolved them in chloroform. On addition of sulfuric acid the red tint characteristic of cholesterin appeared, increased and gradually became darker. A parallel test with pure paraffin was negative, the wax remained white.

The proof, therefore, that the molds were made with our paraffin during the experiment, is absolute. We can affirm this categorically, basing the assertion not only on the detail of the mode of experiment, the precautions taken, and the evidence of our senses, but also on the blue coloration identical in the molds and the wax in the tank, the incidental inclusion of the crumb of coloring matter in the mold of the foot, and finally on the chemical reaction revealing the presence of cholesterin

To sum up We obtained molds of hands and feet of children, anatomically perfect, when there was no child present. The molds were produced with our paraffin during the séance. As the only possible fraud would have been that molds already made should have been brought in, we can affirm positively that our molds were of supernormal origin. There is also another proof, accessory but still important, of the authenticity of our molds. It is this: The casts of children's hands and feet which we have obtained all have the characteristics of the skin of an adult of a certain age. The medium is fifty years of age.

Nothing is more striking than the contrast between the size of these children's hands and the signs of age manifest in the furrows, the lines of the hand and the creases of the skin This contrast had already been remarked on by Mr Oxley, in a letter, February, 1876, to M. Aksakoff "It is a curious thing," he wrote, "that in these molds the distinctive signs of youth and age are always found This proves that the materialised members while keeping their juvenile form show particulars that betray the age of the medium."

It is easy to put together the complexities *necessary to a fraud in the case of the molds* we obtained The implications would be the following

1 The medium models, or gets someone to model, artistically, the hands of adults in different positions.

2. He gets some of these reduced in scale to the dimensions of children's hands. Such reduction is possible by the mechanical procedure of modern statuary, but it is nevertheless a job for an artist. One might also wonder at the absurd idea of not using the hand of a child instead of reducing that of an adult.

3. With the models so obtained he makes hollow molds, most artistically, so that the joints should not be observable.

4 Into the hollow molds he pours some substance, both fusible and soluble, for, according to the preceding there seems to be no other possible method, as far as can be imagined.

5. He dips these casts into hot paraffin, and then dissolves them out in cold water to obtain the residual gloves.

6. These *gloves* being extremely *fragile* by reason of their thinness, the trickster cannot think of bringing them in his pocket. He therefore places in a padded box the one or two molds to be exhibited at each séance. (It is highly probable that to perpetuate a fraud he would have been irresistibly impelled to make thick molds, easier to make, safer to handle, and less breakable.)

7 He conceals this box in a pocket so as not to be suspected. (This alone is a problem difficult to solve.)

8. At the experiment he adroitly frees one hand, gets at the box, opens it, takes out the molds and puts them on the table, splashes the paraffin and throws it about, puts the box back in his pocket, and replaces his hand in that of the bemused controller, who sees nothing of all this manoeuvering!

Well! let us suppose all this farce successfully carried out, however complicated and unimaginable, what would have been the result? All this astounding skill and unheard of roguery would have come to nothing: it would have been unmasked by the unexpected control of the color and the secret admixture of the chemical, dissolved in the paraffin. Is it necessary to draw the inference? The conclusion imposes itself on every open-minded reader. There is no need to insist upon it. All the objections hitherto made have been frivolous. We have as yet waited in vain for any serious scientific discussion of our experiments.

I do not wish to close this article without a word on the philosophical deductions from ectoplasmic molds and ectoplasm in general. I must necessarily be very brief, referring such readers as are interested in the question to my book—"De l'Inconscient au Conscient." ("From the Unconscious to the Conscious." Translated by Mr. Stanley de Brath and published by Harper and Bros.)

For metapsychic science, materialisation is no longer the quasi-miraculous manifestation described and discussed in old spiritualist books. It should be considered entirely apart from mystical theories or ideas, by proceeding from the known to the unknown; by seeking to understand what we do not know from what we do know.

What we know as regards ectoplasmic forms is that the materialised organ is a temporary creation dependent upon the organism of the medium. Proofs of this are super-abundant and leave no doubt whatever

What we do not know is from what directing idea the materialisation proceeds. Is it a matter of subconscious idea in the medium? Is there an extrinsic direction, such as that by a "spirit"? We do not know

Nevertheless, in proceeding always from the known to the unknown we can base our notions on two sure observations: The subconscious is immeasurably vast; it contains faculties and knowledge unknown to the conscious mind, and even secondary personalities very different from the normal personality And the subconscious has certainly a power of organising matter, called the ideo-plastic power Logically and if we are faithful to scientific method, we ought to explain all ectoplasmic manifestations and materialisations by *the exteriorisation of a part of the organism of the medium in an amorphous state and by the subconscious ideo-plastic organisation of the substance so externalised.* This is, of course, only a working hypothesis. It seems very narrow to cover the whole of the known facts, and possibly may very soon be found insufficient But, of course, it is for the present the only hypothesis conformable to positive scientific method.

Let us make no mistake this hypothesis, *taken as it stands, is* formidable. It revolutionises entirely our classical concepts of matter and life. To give one example only —From the philosophic point of view, what does the notion of ideo-plasticity signify? It signifies that the idea can no longer be taken to be dependent on and produced by matter. On the contrary, it is the idea that molds matter, and gives to it form and attributes. This is the complete reversal of materialist physiology and the organo-centric notion of the individual.

A living being can no longer be conceived of as a mere complex of cells. It appears primarily as a *dynamo-psychism*, and the cellular complex which constitutes its body appears as nothing less than an ideo-plastic product of that dynamo-psychism. Matter counts for nothing, it is the idea that is everything here. To proclaim this truth that what is essential in the individual is not bounded by his organism, by its restricted senses, or by its limitations in time and space, it is to affirm, not as a mathematical certainty, but as the result of weighing probabilities, the pre-existence of the essential being and its survival of its bodily objectification.

Why Headlight Glare?

(*Continued from page 330*)

traffic regulations should provide for minimum road illumination consistent with safe driving as well as a maximum glare. They contend that headlight manufacturers can remedy matters very materially by equipping new cars with lenses and lens mountings in such a manner that they will fit together only when the lens is in a correct position. They suggest that some easily operable method of removing the lens should be perfected in order that the cleaning of the lens and reflector and the replacement of the bulb would be facilitated. Furthermore, an external focus adjustment should be provided in all headlamps. Very few drivers realise that it is necessary to refocus the lamps each time a bulb is replaced on account of the slight difference in positions of the filaments in different bulbs and the possibility of accidental change in position of bulb socket during such replacement. The lamp assembly should be made such as to positively locate the bulb reflector and lens with respect to each other so as to maintain this relative position. Headlamps could also be advantageously mounted so as to be protected from displacement by collision while [illegible]

accidental displacements should be provided.

The common practice of the average driver of switching off his bright lights in passing another car may prove dangerous on a dark road unless the car is being driven very slowly for it takes the driver's eyes an appreciable length of time to adjust themselves to the new conditions and until such adjustment is made, the driver is practically blind so far as seeing the highway ahead is concerned. Many drivers adjust their lamps so that they will throw considerable light up into the air possibly in order to better see highway signs. All such guideposts should be placed at heights at which they are readily discernible with headlamps that are legally satisfactory The results of the Bureau of Standards' investigation of the headlight conditions of 400 average automobiles are appropriately summed up in Uncle Sam's conclusions (1) Few motorists are gaining maximumly satisfactory illumination service from their headlights. (2) There is a real need for general public education regarding the necessity for and the means of adjusting headlights. (3) A test screen is simple and inexpensive and in general the required lamp adjustments are easily made (4) The installation of an approved device does not in itself mean a safe or legal light. It must be kept in proper adjustment for satisfactory illumination (5) Reducing glare with an approved device invariably results in more and better road illumination

Ball Bearings and How They are Made

(*Continued from page 331*)

piece of silver steel can detect instantly by the sense of touch the presence of any undesirable soft spots in the race Suitable instruments are relied upon to establish whether or not the ball track is true to form, of correct diameter, and placed exactly midway between the sides of the ring Needless to remark, the ball-rack on the oppositely facing inner or outer ring must be concentric with its neighbor Apparatus, based in principle upon magnifying calipers, give readings in ten thousandths of an inch.

The balls in a bearing are held in their designed positions between a set of rings by means of what is known as a cage Depending upon the type of bearing, these cages may be made of white metal fashioned by die casting or they may be worked up from brass tubing fed to automatic lathes. In either case, the product must be formed with due regard to exactness. The final operation in the manufacture of a ball bearing is to assemble its several parts. This would hardly be satisfactory if the rings, like the balls, were not nicely graded according to their refinements of size This makes, in a measure for what is termed "selective assembling," which assures perfection of fit and the utmost smoothness of running. These characteristics, in turn, contribute to long and successful service.

Keeping Our Water Fit to Drink

(*Continued from page 332*)

ber of organisms in the water through sedimentation, by the appearance of the organisms under the microscope—the coloring matter being knocked to pieces, so to speak. Sometimes there is an increase in the water bacteria which feed upon the decayed organisms. The *Cyanophyceae* may produce scum after treatment which is of varied colors, pale blue, yellow, red or brown

The usual method of applying copper sulfate has been to drag burlap bags containing about 50 pounds each through the water by means of row boats, taking a zig-zag course so as to triangulate the surface of the water Wind, waves, diffusion and gravity admix the streaks of treated water with the remainder It is remarkable how successful have been treatments made in this crude manner On the extensive reservoirs of the watersheds it is necessary to use launches and in the last few years that portion of Kensico reservoir lying between the influent and effluent gatehouses has been successfully treated in two days' time with approximately 6,000 pounds of copper sulfate. This treatment has been made on several occasions at different seasons, including winter On many other occasions 3,000 pounds have been applied to Croton Lake and once on Kensico reservoir In these launch treatments of large reservoirs parallel courses about 100 feet apart are usually taken.

Beginning in January 1920 a new departure was made. Copper sulfate was applied continuously for weeks at a time, aggregating three months of the year, to the water in the aqueduct at Pleasantville, about

an hour's flow above Kensico reservoir. The chemical feeds through a hopper to a moving shutter actuated by a motor and adjustable in stroke. The chemical drops through a wooden chute into a floating wooden crib bored full of holes. The electric feed originally designed for over 17 tons a day has fed 400 pounds a day within a pound error. No attention at night has been required. This continuous dry feed of copper sulfate to the water has been eminently successful. The dosage of chemical is definitely known and the application and admixture with the water thoroughly under control. At winter temperature 0.2 parts per million killed Asterionella and at spring temperature 0.12 parts per million.

The recent trouble with Synura deserves special mention. Experience with this organism goes back many years but the amount causing trouble was the smallest in that experience. The Brooklyn supply suffered from it many years ago and the Croton supply in 1900. On those occasions there were about 300 to 500 units. Synura has been present in Ashokan reservoir in all four years, 1918, 1919, 1920 and 1921, but up to last year the measures taken had been effective. It began to appear in August and was present in about 100 units by October. Watch was kept for it in the water entering Kensico reservoir but as it escaped discovery, it was assumed as in the experience of the previous years that it was destroyed by the Ashokan aerator and by passage through the miles of tunnel with its many invert syphons and particularly by the pressure of 700 pounds per square inch to which it was subjected in passing under the Hudson River. However, a sufficient quantity must have survived to seed Kensico reservoir and about 100 units became prevalent there by the middle of December. At that time complaints of fishy taste began to come in from upper Manhattan. The water had practically no odor but the taste was traced back to the chlorination plant. It was noticeable after but not before chlorination. The dosage of chlorine was 0.3 part per million, and the chlorine was killing the organism and setting free the oil. It happened that Hillview reservoir at the time was out of service. The first measure taken was to put Hillview into service, expecting in accordance with previous experience with other organisms that the two days' storage would remove the taste. It did not. In fact the taste passed through double filtration of sand and charcoal in the Municipal Building in lower Manhattan. As Kensico reservoir froze over in the sudden cold snap that occurred about that time it was impossible to treat the reservoir direct. Automatic treatment of the incoming water with copper sulfate was started at Pleasantville. Owing to the failure of Hillview reservoir to remove the taste, the next step was to bypass Kensico reservoir, since only about fifty units were coming from Ashokan reservoir. But the treatment with copper sulfate at Pleasantville followed by chlorination at Kensico brought out all of the taste of the organism so that a second wave of complaints swept over the city. The next attempt was to avoid destruction of the organism by stopping treatment with copper sulfate, shutting down the Kensico aerator and reducing the chlorine to 0.1 parts per million. This produced a nearly tasteless water at Hillview reservoir, but accumulation of the organism in local sections caused further complaints. The next step was to shift treatment with copper sulfate to Ashokan screen chamber. This was first tried experimentally for 12 hours so that if unsuccessful the treated water could be caught and held at Hillview reservoir. The object was first to learn whether the copper sulfate would kill the organism in the aqueduct in the absence of light and second whether the passage through the long 92 miles of aqueduct would remove the taste. Samples, of course, had to be accurately timed for flow in the aqueduct. After two experiments it was learned that 0.12 parts per million copper sulfate killed the organism almost completely at least 60 per cent, 0.18 parts gave similar results, but 0.25 parts completely destroyed the Synura and so quickly that the water was tasteless when it reached Hillview reservoir. Consequently treatment at Ashokan was started continuously with 0.25 parts copper sulfate and Kensico aerator put into operation again. Meantime it was learned that after killing the organism with copper sulfate, the chlorine did not increase the taste, hence dosage was increased to 0.3 parts per million again. Since then the water reaching the city has been without the cucumber flavor.

In order to learn other means of handling such a situation (which had a decided bearing upon the other large supply, the Croton), the next study was to increase the chlorine. As the apparatus was feeding its maximum at Kensico, the flow of water was cut down, running the excess into Kensico reservoir. It was found that 0.6 to 0.75 parts per million chlorine destroyed the taste and after 12 to 24 hours the chlorine could not be tasted. A similar experiment on a smaller scale was tried on the Bronx pipe line blowing off the water to the Harlem River, and it was found that 0.6 to 0.75 parts chlorine both killed the organism and removed the taste and yet the chlorine could not be tasted after flowing the 15 miles through the pipe line, time 15 hours. Following this experiment the pipe line was in service a week with chlorine dosage at Kensico dam of 0.6 to 0.75 parts without causing complaint in the city. As a result the chlorine equipment has been increased at Kensico so that the entire Catskill supply is now handled by this method. In the solving of the difficult situation created by the Synura, hundreds of samples were taken and tasted and it became necessary for Deputy Chief Engineer William W. Brush to assume personal direction of the extensive large scale experiments carried on.

Shifting Speeds with an Oil Pump

(*Continued from page 334*)

ential gearing, when the speeds of the two road wheels vary, one of the motor units will receive a greater quantity of oil than the other, the sum total of the two always balancing the output from the pump. Thus the two motor units in themselves virtually constitute the differential. Although in the case of many appliances an equal speed is necessary in either direction, in the case of automobiles the reverse speed would, of course, be limited. It will be impossible to put the gear into reverse without first bringing a car to a *standstill*, skidding excepted. It is true that by tilting back the socket ring too quickly the gear would act as a powerful brake and cause the wheels to skid, but that would be the result of almost incredible clumsiness on the part of a driver.

Assuming that back-wheel brakes are still retained, they can be operated by a pedal, dispensing with the side brake shaft entirely, for it is obvious that the variable speed gear will serve the purpose of a powerful brake. The clutch, gear box, cardan shaft, universal joints and back axle gearing will become nightmares of the past. The driving of a car will resolve itself into the manipulation of a throttle lever and all clutching and declutching, gear changing and ordinary braking will be done by means of a small hand wheel or lever, requiring practically no effort. It is almost literally true to say that we shall have our fingers on the pulse of our engine. Another and by no means an unimportant feature is that most of the dirtiest work in attending to his car that now devolves upon the owner driver will be cut out of his program.

The Heavens in November, 1923

(*Continued from page 344*)

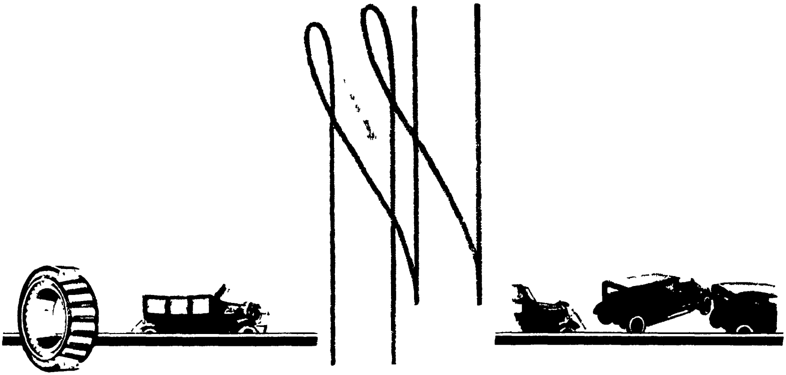
and practically invisible all this month. Could we but see him in the glare, we might watch him pass behind the sun on the day of conjunction, when he is actually concealed for several hours.

Venus is now an evening star; but poorly placed, near the sun and south of him, so that she sets before 6 P. M. even at the end of the month. On the 4th she is in conjunction with Jupiter, and less than a degree from him, but both planets are too deep in the twilight to be observable.

Mars is a morning star, rising at 4 A. M. in the middle of the month, but is still a long way off and correspondingly faint. Jupiter is an evening star until the 22nd, and a morning star afterwards, but is practically invisible. Saturn is a morning star, rising about 4:30 A. M. in the middle of the month.

Uranus is in Aquarius, and comes to the meridian in the early evening. Neptune is in Leo, and is observable in the early morning.

The moon is in her last quarter at 4 P. M. on the 1st, new at 10 A. M. on the 8th, in her first quarter at 4 A. M. on the 15th, and full at 8 A. M. on the 23rd. She is nearest the earth on the 5th (when we may look for high tides), and farthest away on the 21st. During the month she passes through conjunction with Neptune on the 2nd, Mars on the 6th, Saturn on the 7th, Mercury on the 8th, Jupiter and Venus on the 9th, Uranus on the 16th, and Neptune on the 29th.



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SCIENTIFIC AMERICAN

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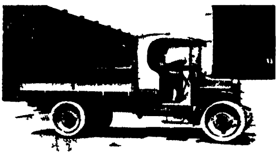

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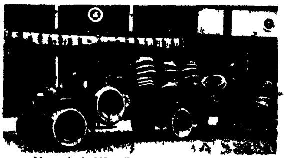

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With the Editors

THERE are many toes to be stepped on in technical journalism. In almost any article which has any pretensions to giving real information, there is generally some statement which gives rise to a protest from some unexpected direction If we say that the thing is white, someone rises to correct us and say that it is black, and that, furthermore, by our statement to the effect that the thing is white, we have committed a grave injustice to this someone and have caused him a serious loss of business. It goes without saying that an immediate retraction of the original statement is demanded, plus more or less gratis-free-for-nothing publicity to heal the metaphorical wound.

IT is surprising how much controversy exists in this world of ours. No one realizes this condition of affairs more than the technical journalist, who is constantly being brought face to face with controversial matters. And if the technical journalist wishes to be unbiased and fair to every one, he finds plenty of additional work to keep himself occupied. If he prepares an elaborate article on some new invention, he is immediately confronted by the statements and arguments of those whose business is bound to suffer from the introduction of this new invention. Indeed, to please everyone concerned, it would be necessary to publish two separate accounts of every technical advance—one dealing with what the advocates would like to read and the other with what the antagonists would like to read. Perhaps it would be better even to publish two separate editions, one for the advocates, and the other for the antagonists. A further improvement on existing methods of publishing would be to send a plain edition, containing nothing but blank pages for the subject in question, to the average, disinterested reader, so that he might not be led astray one way or another!

BUT then there are times when the technical journalist is really at fault Despite the utmost care in gathering facts and in weaving them into an interesting yet disinterested account, misstatements of fact will sometimes creep into our columns. The editorial mind is always keen and alert for possible misstatements in articles contributed by outside writers, in truth, writers are relied upon for accurate facts only after they have established a reputation for accuracy, and they are immediately cast into disfavor when they are found to be inaccurate The SCIENTIFIC AMERICAN has long prided itself on its editorial accuracy But for all that, mistakes occasionally creep into our columns. When they do, they are soon called to our attention by our very observing and well posted readers. And in a spirit of fair play, as well as a desire to give the authentic information, we are always ready to acknowledge and correct such mistakes.

OUR Abrams investigation and our psychic investigation are in full swing In this issue will be found the results of another test sitting with an independent writing medium, together with the report of our committee, as well as the comments and suggestions regarding our first electronic reactions test, which was reported in the November issue. Never have we dealt with a subject that aroused such interest as the Abrams investigation. Letters are coming in from all parts of the country. We are hearing from orthodox doctors, who in some instances condemn us for devoting any attention to the extravagant claims of electronic technique, and in yet others compliment us for our initiative. Then there are letters from electronic practitioners, who are equally complimentary and anxious that we examine the matter thoroughly, so that their remarkable claims may be substantiated. This investigation, according to present signs, is not going to be an easy one. It is going to take time It will require much patience A plan of campaign has been laid out which takes into consideration the establishing of the more elementary facts before proceeding to the more involved, and, at intervals, certain check backs to verify our sum total of findings.

IN an investigation such as ours we must work entirely with first-hand information We welcome letters giving experiences with the electronic diagnosis and treatment, we welcome reports from doctors and electrical research workers and others who have conducted tests of their own with the technique and the apparatus involved, we welcome suggestions from Dr Abrams and his vast number of students and workers. Already we have a vast amount of such material on hand. Still, in the final analysis, it will be the facts which we obtain ourselves from face-to-face contact with the entire subject matter which will swing the decision of our committee

OUR next issue, carrying the January date is to be largely devoted to the automotive industry It comes at that time of the year when virtually all the automobile manufacturers have announced their new offerings of the season, and when the average man is giving some thought to his next car Perhaps its most significant feature will be the price chart, which will give at a glance the story of each type of automobile and motor truck then on the market This chart, representing a compilation of a large volume of data gathered from the makers, will give the number of cylinders, the horse-power, wheel base, tire size, and price Thus the reader will have before him in tabloid form the entire story of the current automotive industry, and, with a given amount of money to spend on a car he will be in a position to invest that money to the best possible advantage.

THE new four wheel brakes and the "balloon" tires will be discussed, along with the several innovations in engine design automatic gear shifting etc The problem of proper lubrication both for the engine and for the chassis will receive special consideration, for it is a proved fact that repair bills are largely based on insufficient lubrication

THEN there is that major problem of motordom—the highway problem What with hundreds of thousands of new cars being introduced each year, in addition to millions of old cars which are still a long ways from the scrap heap, the highway situation is becoming serious. Our motor laws are fast becoming hopelessly obsolete The inter-state tourist has brought about an urgent demand for the standardization of laws throughout this broad land of ours Accidents due to careless driving, headlight glare and other causes complicate automobile legislation still further All of which comes in for due consideration in our January issue, which will be the opening gun of our campaign to solve the highway problem

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DECEMBER, 1923

LEADING ARTICLES

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DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN, President ORSON D MUNN, Treasurer
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Vol. 129, No. 6. Published monthly Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3 1879

Price, 35 cents a copy $4.00 a year Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5 00 a year, postage prepaid.

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, DECEMBER, 1923

A Wheelless Motor-Car

By Dr Alfred Gradenwitz

THE designing of motor cars moving on runners instead of on wheels is no absolute novelty in itself In fact, on perusing the annals of patent offices many examples of schemes such as this could be found, though none of them has got beyond an experimental stage. It was left to a Berlin inventor, R. Venslaff, to perfect the first full-size vehicle of the wheelless type, and as the writer has had the good fortune to inspect it in actual operation, the account given in the following does not tell what is planned for the future, but what has actually been achieved and already is in being

The new vehicle comprises two pairs of runners three meters long, which, like the four feet of a horse are alternately raised and lowered, the runners of each pair, the outer as well as the inside one, being rigidly connected with one another Supposing the underframe and body of the vehicle to rest on both pairs of runners, the engine will at first lift the two outer runners, leaving the car to rest on the inside pair, and, after moving it forward a certain distance (1.3 meters), will put them down on the soil, in order, immediately afterwards, to commence the same operation with the inside runners.

The main difficulty met with in connection with any previous attempt to solve the problem was that the pair of runners temporarily lifted from the ground could not be lowered quickly enough, and placed in front of the underframe, to enable the latter to move along uninterruptedly and without a hitch. This is for the first time realized in the new vehicle, where the pair of runners temporarily raised from the ground move forward past the underframe at a more rapid rate than that at which the latter will presently glide across the pair of runners happening to rest on the ground Inasmuch as the runners actually constitute rails on which the rollers carrying the underframe are gliding, the consumption of energy is extremely low Actual tests have shown a load of 6 to 8 tons to be conveyed by the vehicle driven by a low-power engine (25 horsepower) at a relatively high speed, viz. 8 to 10 kilometers per hour, irrespective of any obstacle, *e g*, tree-trunks lying on the road. The vehicle, as it were, throws a bridge across ditches, which accordingly are traversed with greatest ease, it will readily negotiate even considerable gradients. Inasmuch as the weight of the engine is of no importance, crude oil engines can largely be used for driving this type of vehicle, thus reducing considerably the working expenses. Entire trains can be formed of such vehicles, though only the front vehicle need be power-driven

The vehicle is without any exertion and without the aid of any complicated mechanism steered from the driver's seat by means of a hand-wheel altering at will the angle between the two sets of runners. Any curve can thus be readily described, the vehicle being even turned on the spot, without any forward or backward motion. The step of the car is under way altered at will between the normal figure of 1.30 meter and zero, thus enabling heavy gradients to be readily negotiated

While the cost of construction of the vehicle is only immaterially in excess of that of ordinary trucks, the wear and tear are reduced to a minimum, there being no friction or slipping on the ground The vehicle will be found especially useful on impracticable ground, on soil to be brought under cultivation

Charles Proteus Steinmetz

JUST as we are going to press, and too late either for preparation of an extended obituary or for the accommodation of such a notice in our pages already made up, comes the news of the death of America's best known engineer Dr Steinmetz was born in Germany in 1865, and received a good education His Socialist proclivities forced him to flee the country and he came to the United States, without funds and with slight knowledge of our language, in 1889 He secured work as a draftsman under an environment that gave ample scope for his natural designing and engineering ability, and his rise to the top of the electrical engineering profession was rapid He soon came into the employ of the General Electric Co., and for many years prior to his death his name was synonymous with the extraordinary development of organized research and the magnificent laboratory maintained by that company at Schenectady Among his peers, he was recognized as the foremost exponent of the union of mathematics and electricity He was responsible for the modern mathematical treatment of all alternating current problems, and Edison characterizes him as the world's greatest practical mathematician To the general public he was probably best known for his high voltage experiments.

With Fire and Fraud

Something About the Acquisitive Gentleman Who Burns Buildings for Profit

By Edward H. Smith

IN THE fall of 1753, Captain John Lancey was ordered to proceed from Biddeford to the Colony of Maryland, with a ship full of brickbats. He raised his hook and sail, dropped lazily down the desultory Torridge and headed into the mysterious West, that region of red wild men and undreamed malevolence. At sundown the young skipper stood on his bridge quaking over the strange emprise that held him, looking forward toward the Colonies he would never see and back at his England, fading in distance and dusk.

At 8 o'clock there was an explosion below decks. The upper parts of the vessel fired like straw Below decks the inexorable sea flowed in, through a great gash the powder had opened in her belly The cargo of bricks bore her swiftly down. No pumps might hope to keep such a wreck afloat till dawn

After some agonies, Captain Lancey got the boat launched and all hands safely aboard They reached England the following day and Lancey reported to his brother-in-law and employer, one Benson, then sitting in Parliament for Barnstaple Benson sent his captain to a proctor, before whom the mariner swore that the firing had been accidental and that nothing could have availed to save the ship or her cargo Benson left England for a tour—and Lancey stayed behind.

A little later, through the tattle of some idle tongue, the captain and his rich relative became suspect and investigation showed that Benson had laden his ship with a cargo of merchandise for America, insured the vessel and her contents for twice the honest value and later secretly had the goods removed and the ship filled with bricks for ballast He commanded Captain Lancey to take her out to sea and set her afire The young man declined until his relative pointed out to him that it was within the latter's power to discharge and beggar the seaman. Then Lancey complied, setting fire to his own ship under his feet by means of an explosive mechanism which rapidly spread the fire

A few sentences from that treasure house of bitterest recollections, Camden Pelham's "New Newgate Calendar," will complete this tale of early commercial arson

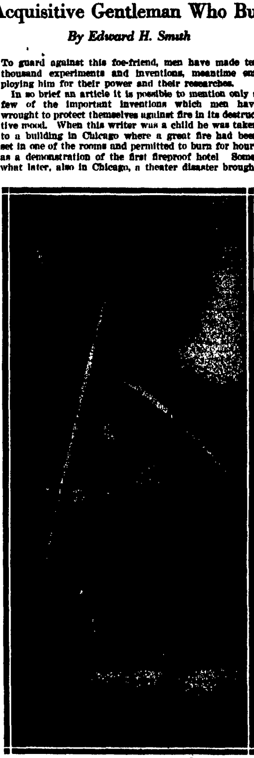
"His employer fled. and his unhappy dupe being brought to trial, was capitally convicted and received sentence of death. He subsequently lay in prison for about four months, during which time he pursued his devotional exercises with the utmost regularity, and was hanged on the 7th June, 1754, at Execution Dock, in the 27th year of his age."

If I recall this old crime and melancholy destination it is surely not to hold poor John Lancey in a piteous extension of impure memory or to expose his name to further obloquy, for he was, as the Newgate Calendar grievously notes, respectably connected and even gently born. My purpose is rather to show the antiquity of arson for profit, a kind of crime now offering both the police and the inventors of this and every country one of their most sore afflictions. The suggestion is not that John Lancey was the first man to burn a house or a ship to get the insurance. Indeed, this crime must be as old as insuring, which is not much younger than trading Commercialized fire insurance sprang up after the great London fire of 1666, though the guilds had provided similar protection much earlier, and, more than likely, Shakespeare's Antonio came into dour Shylock's grip through the need of a premium for marine insurance—to cover those delayed "argosies in Tripolis, India and Mexico" So, Lancey is but a reminder

In beginning to write of fire as a criminal instrument, some ironies and strangenesses are to be noted Fire, the one pure element of the ancients, employed for foul impurities, fire, the source of light, in the service of the forces of darkness, fire, the great reagent of the alchemists, by which man was to gain the secret of high fortune and lasting life, used to spread misery and death, the deep-searching flame of Hermes Trismegistus, Zosimus of Panopolis and Paracelsus Hohenheim in the hands of Benny the-Bake and the Firebug Kid!

The historic conflict between man and his Promethean friend and Satanic enemy began in the bone-strewn grottoes where the dawn man gnawed the joints of his roasted prey, or in the vanished forests that burned and consumed wandering tribes of hunters in ages forgotten and lost It continues in the age of concrete and steel To guard against this foe-friend, men have made ten thousand experiments and inventions, meantime employing him for their power and their researches.

In so brief an article it is possible to mention only a few of the important inventions which men have wrought to protect themselves against fire in its destructive mood. When this writer was a child he was taken to a building in Chicago where a great fire had been set in one of the rooms and permitted to burn for hours as a demonstration of the first fireproof hotel Somewhat later, also in Chicago, a theater disaster brought



Firemen working on an incendiary fire in a city dwelling house

about the installation of asbestos curtains in theaters and the general adoption of fireproof construction. Since that day many other installations have been made—all steel railroad coaches and sleeping cars, great buildings without an ounce of inflammable material in their structures, automatic sprinkler systems for flooding buildings with water at the first outbreak of fire, other automatic systems which sound alarms when any fire breaks out, steel, glass and porcelain office furniture, special insulation to provide against fire from electric wiring, etc In spite of all these improvements and steps of progress, America remains worse afflicted with fire losses than any other western land, a curious fact when one brings to mind the old cities of Europe, with their narrow cluttered streets, their lack of fire fighting apparatus and the dry mould of their centuries.

Just why fires should be so prevalent in America is difficult to say. Authorities disagree and flounder. All we can know definitely is that a tremendous struggle is in progress in this country between destructive fire and the agencies of defense and preservation. Fire insurance companies have naturally taken a leading part in this effort to reduce the fire loss. Their strength has been expended mainly in combatting the accidental fire, the fruit of carelessness, forgetfulness and stupidity in man

But there is a far deeper and darker struggle than this going on between civilization and withering fire. Like every other tool which honest men have used for the advancement of civilization and social order, fire has been and is being used every day by criminals. Poor John Lancey is abroad in the land, converted into a professional fire setter, an arson specialist. He is in all communities. His ruins monument every townsite in the land.

The story of the fire-setter is of itself an old and stale one. Purposeful fires among merchants became a common jest before the birth of any man now living. We all know how old and simple a thing it is to insure a $5,000 stock for $8,000 and shortly set the match. But such tricks have become more and more difficult since the insurance companies and the various associations of creditors have come to realize their own peril and the methods of fire setters. Insurance investigations are now reasonably rigid, whereas they were once pitifully lax. The action of creditors is, in this day, remarkably swift and consecutive. It used to be slow and easily exhausted In brief, the firebugs are now being resisted and punished. The result of such action has not been to drive them out of business, but to sharpen their wits and stimulate their inventive faculties. How to set a fire and not be caught at it? This is the chief preoccupation of a large and growing class of criminals against whom no really effective measures have yet been developed.

The rationale of commercial arson needs to be understood It has often been said that firing seldom figures in fake bankruptcy cases. The truth is otherwise. If a crooked merchant wants to go fraudulently broke and thus cheat his creditors, he must get rid of his goods somehow To remove and hide them, thereafter claiming bankruptcy, is the simple course, but a search is always made Many crooked merchants consider it far cleverer technique to burn out their nearly empty stores after the valuable part of the stock has been secreted In that case the creditors seize the insurance money, but what matter to the thief? He has his goods. Why should he care if the loss is shifted from the shoulders of those who trusted him to the backs of those who insured him? Moreover, there is always the older device of over-insuring. In that case the creditors get what's coming to them and the burnt-out merchant takes the balance, plus the hidden merchandise In still other cases, no creditors figure. The arsonist has simply disposed of his paid-for goods and then burnt out his shell of a store

In every case where arson is committed the problem of safety for the criminal plays a leading part. How to set a fire that will burn so swiftly and hotly as to destroy all evidences of arson before the fire fighters can possibly quench it? How to touch off a fire when the persons interested in the insurance are demonstrably far away? How to do this without the employment of untrustworthy intermediaries? There are the questions which always face the fire setter How he meets them is the heart of this article

I am indebted for much of my material to that most eminent authority on arson and credit frauds, Mr. C D. West, at present chief investigator for the National Association of Credit Men. Mr West has run to ground more expert arsonists and solved more strange fire mysteries than any other detective officer now living, and accordingly occupies a special position in the world of crime suppression.

One of the recent devices employed by mercantile fire setters was recovered from a store in downtown New York not long ago when a watchman in the building made an unwelcome intrusion and found the infernal machine before it had had time to do its work. It consisted of the shallow round top of a batter tub. This wide inch-deep saucer had been filled with cotton wool impregnated with petroleum or gasoline. In the center of this inflammable mass stood a short piece of candle, which was burning when the thing was found. To the

outer edge of the saucer had been tacked twelve or fifteen little upright pieces, the top of each supporting a small bladder of very thin rubber. Each of these little bladders was filled with five or six ounces of gasoline and tied shut securely. Similar fire machines have been found in which one or two cow's bladders had been used, each laden with three to four quarts of the popular motor fuel.

The theory of this mechanism is simple enough. The candle in the center had been cut to a length which would burn for nine or ten hours before reaching the oil soaked cotton wool. It had been lighted at six o'clock, when the proprietor of the shop had closed his door and gone home for the night. It would do its deadly work between three and four o'clock in the morning. As soon as the candle burned itself short enough to set off the cotton there would be a considerable flame. This would heat the gasoline in the little bladders. In a few minutes the expanding gas would burst the bladders and throw the flaming gasoline to all parts of the store. Flame would thus spring up in a score of places at once and the explosion would surely destroy all vestige of the mechanism. To make sure of the work's success, the floor had been soaked with gasoline at various points and the part of the store nearest the pyrotechnic mechanism had been heavily draped with kimonos, lace curtains and other highly inflammable materials. In this single case the firebug failed. In how many others of the sort did he succeed!

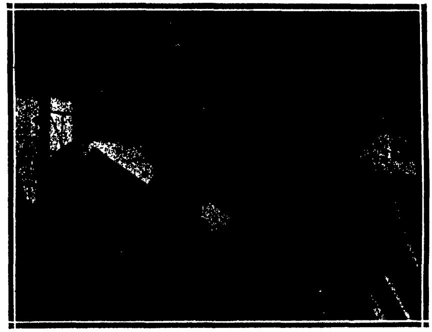
In one of the upstate cities of New York, not long ago, an Italian grocer and general merchant occupied the ground floor of a frame building. An outside stairway ran to the second floor, where a Syrian artist lived with his wife and children. In the basement of the premises was an old fashioned hot-air furnace, the pipes from which ran to registers in both floors.

A little after eleven o'clock, on a cold night last winter, the wife of the Syrian living in the upper story awoke from sound sleep and smelled a strong odor of gasoline. She hesitated for a few minutes, but as the odor grew in heaviness, she threw on her clothes and started for her husband who was at a lodge meeting two or three squares away. Just as she opened the door he came in and recoiled from the gas. He went downstairs immediately and, not without some suspicion, forced his way into the Italian's grocery store. Just as he did so, he saw a shadowy figure retreat to the alley and drive off in a motor car, which had been standing close by with lamps out.

Inside the store the Syrian found a five-gallon water cooler standing on a shelf, with the spigot turned so slightly open that the contents dripped from it drop after drop. Underneath this device were piled two cases of parlor matches with a gross of large boxes in each. These matches were already swimming in the gasoline dripping from the water cooler. In the center of the floor stood two galvanized tubs which were half filled with gasoline. Not less than twenty gallons of this hideous inflammable had been provided for the fire.

The Syrian turned off the gasoline dripping faucet of the cooler, opened the doors and windows to allow the exhalation of the gas and set off for the Italian's home, some distance away. To his intense surprise, he found a celebration going on. The Italian's baby son was being christened, and among the guests at the party were the chief of police, some other city officials and some politicians, among whom the Italian grocer ranked himself. The grocer tried to put the Syrian off. First he said the thing could be of no importance and that he would not leave his baby's christening because a little oil was leaking. Then he said he had given the keys to the baby and they had been lost. Finally, the irate Syrian appealed to the police chief and that official decided that his public duty was somewhat more urgent than his social obligation. He entered the shop, found the saturated matches, the water cooler still half full of gasoline, the tubs of inflammable liquid on the floor and a general arrangement of materials for a quick, disastrous fire.

Undoubtedly, had the Syrian and his family been in their beds on the upper floor when the crash came, they would have been blown to kingdom come. The Italian had expected the furnace in the basement to cause the conflagration, as soon as enough of the gasoline from the water cooler had dripped through the floor and formed a gas. But, to make doubly sure, he had sent his brother to throw some bit of burning stuff into the store. This was the man who had been seen slinking off to the motor car in the alley. The plotters were naturally committed to Auburn, where they still abide.



The interior of a store after a conflagration of suspicious origin

Because of the scientific recognition of the fact that fires may originate spontaneously in certain materials under special circumstances, and because of the wide publicity of the term spontaneous combustion many efforts have been made among fire setters to simulate this natural phenomenon. Where such work is well done the chance of discovering the plot is small. False spontaneous combustion is, therefore, popular among the professors of arson.

One method of simulating a natural outbreak of fire is as follows. The fire setter takes an old barrel and packs it half full of oil waste, with a tiny spark burning in the middle. He then packs the barrel full and tight with old clothes, greasy papers and other materials of this sort. The little fire in the center of the greasy waste will smoulder for six hours or for sixty, according to the closeness of the packing. Finally, however, it will burst into wild flame and set off anything within reach.

Such spontaneous combustion barrels are often employed by dry goods and clothing merchants. The barrel is prepared with its spark and put into the rear of the store, where windows are kept open to carry off the odor of the smudge. The arsonist knows, of course, about how many hours must elapse before the illumination. Usually he waits for a week-end. He closes his shop at dusk on Saturday and goes about his pleasure. He has not, of course, forgotten to sprinkle a good bit of gasoline about near the smouldering barrel. Neither has he neglected to hang up coats, dresses, curtains, wrappers and all sorts of loose combustibles where the first flames will reach them.

Thirty-odd hours afterward, the smudge in the barrel breaks into brilliant flame. The fire spreads quickly to the gasoline-impregnated wood and the fire-hungry hangings. The store is gutted in a few minutes. Before the fire machines can arrive from any distance, the whole place is an oven and when the water from the hoses finally gains control of the fire the interior of the place has been so completely burned out that it is impossible to determine whether the best merchandise of the place had been removed in advance. In case the fire is found and got under hand before it has a chance to flare up well, the origin of the blaze must be found in a barrel of waste and only the expert will suspect that this spontaneous thing was a work of art.

But the individual fire setter is no longer so great a menace as once he was. The big and successful cases of commercial arson are managed in these times by organized gangs or arson rings, as they are called. Such cliques of fire specialists now operate in all parts of the country and a number of them including all the members, have been sent to prison through the work of Mr. West and others.

The arson ring consists of the fire insurance agent, the insurance inspector, the crooked merchant, the expert fire-setter and the insurance adjuster. The merchant wants to have a fire. He resorts to the crooked agent who writes him a policy for far more than the value of the stock. The crooked inspector goes over the property, blinds his eyes to the fraud and approves the risk. In a little while the professional arsonists come along, remove as much as they think wise of the stock, saturate the place, set a pyrotechnic bomb of some sort and burn up the merchant's store. The business man is always away on a short vacation when such a blaze is produced. He comes back with great celerity, however, once his store is gutted, and puts in a howling complaint to the insurance agent. Now the interesting part of the comedy is played.

The crooked agent, who originally wrote the policies, sends the claim to his company with the recommendation that it be paid, as the loss is complete and the merchant a worthy man. The claim is passed to the adjuster, who proceeds to make an examination. His business is to find fraud if any exists, but in this case he makes it his business to overlook any that he may find. He reports to the company that the fire was *bona fide*, that the loss is complete and that payment should be made. The merchant gets his money promptly and divides with the other members of the ring. Simplicity and precision are the virtues of this plan of action. It is applied to many other types of insurance.

Sometimes the romantic and extravagant enters into the doings of the arson committee and lights this dark subject with a flare of infernal glory. The story I have to relate in this connection has been told by me before and by others, not too scrupulous about literary proprietorship.

A few years ago a boardwalk shoe dealer in Atlantic City vanished with a large stock of costly merchandise. Mr. West, sent to find the absconder and his wares, found among the few papers left behind by the vanisher, a *bill for a dozen animal satchels*. He could not imagine what a smart shoe shop might want with animal satchels until he discovered that they had been reshipped to the address of a man of the same name as that borne by the shoe merchant, in a small Pennsylvania town. The investigator hurried thither and found that the recipient of the animal satchels was in fact the father of the vanished shoe merchant. Let us call him Schwartz, since that was not his name. The elder Schwartz had been a merchant, had suffered several fires, all of them disastrous to the insurance companies and had finally retired. His son had then entered the mercantile field, with results already noted at Atlantic City.

Mr. West knew at once that the elder Schwartz was a rogue and one to be approached with caution. Accordingly he began his campaign by indirection, asking questions here and there among Schwartz's townsmen and neighbors. Finally, he discovered that Schwartz was supposed to be an animal trainer. His past disputed this. The shipment of animal satchels confirmed it. Mystery! A little more watching and questioning decided the investigator on his course. He went away for a time, only to reappear in the garb and personation of a circus man. In this character he called on old Schwartz and was most coldly received. But he managed to force his way into the house. Only the feebleness of the old man rendered this physical trumping possible. In the kitchen Mr. West found a specially fitted gas jet over a small table. Under it snoozed two cats. One of them got up as he came in, arched her back lazily, lifted a paw and pulled the short chain of the gas tap lighting the mantle from a small pilot. I suppose every reader will be familiar with such gas lighting apparatus.

West needed to know no more. He understood that old Schwartz was training cats for arson. A merchant who wanted a fire bought one of the cats and had a gas jet rigged in his shop, preferably in the basement. A little pilot, which burned day and night, set off an ordinary gas tip. The cat had her table just under this device and amused herself by playing with the chain, turning the flame up and down as old Schwartz had taught her. Then came the night of disaster. The merchant removed the tip from the gas jet and when pussy pulled the chain a great flame sprang up igniting inflammables which had been arranged above it and

(*Continued on page 437*)

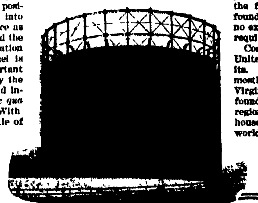
The Fuel of the Future

The Advantages of the Universal Burning of Gas, and the Obstacles in the Way of Its Attainment

By Ismar Ginsberg

MUCH has been said, these twenty years of rising fuel prices, about the fuels of the future and even about the fuels of the present. The present article develops an angle of the case to which far too little attention has been paid. Mr. Ginsberg reminds us that all fuel—coal, wood, oils or what you will—must be vaporized before or during combustion. He points out the incontrovertible fact that conversion of solid or liquid into a gas fuel can always be done more cheaply and more efficiently on a large scale in a special plant than on a piece-meal scale in the consumer's oil stove or coal furnace. Ergo, he tells us, the fuel of the future is unquestionably gas, and the gas tank which adorns this box ought to be the universal symbol for heat, light and power. To which we can think of only one rejoinder—Why not?—The Editor

WHEN the paleolithic Man discovered fire and learned that the earth about him abounded with matter that could be burned and in burning could furnish him with heat not only for bodily comfort in the cold of the winter but also for fashioning tools and weapons and for cooking his food, fuel first assumed its position of transcendent importance in human affairs. This position has gradually developed into one of even greater significance as society grew more complex and the arts and sciences of civilization were evolved until today fuel is undoubtedly the most important single commodity employed by the human race in their home and industrial life. Fuel is the *sine qua non* of modern civilization. Without it, there could be but little of the comforts and luxuries of life, industrial enterprise would be practically nil—in fact, society, as it is constituted today, could scarcely exist. It is therefore not at all strange, when disruptive forces, such as strikes, make their appearance in the news of the day, that each and every member of society should become greatly concerned over the matter and be apt to view them as blows directed against the very foundation of the structure of modern life. A greater calamity cannot be imagined than the sudden shutting off of our supplies of fuel.



A fuel is a substance in which there is concentrated great heating power. This power or energy is released when the fuel is brought to the proper temperature and burned. It is well known that all fuels do not burn with the same degree of readiness. Thus, while a piece of paper can be ignited by the heat of a burning match and similarly the stream of gas issuing forth from the gas burner, nevertheless wood must first be heated upon a paper fire before it will itself catch fire and burn. On the other hand, coal is still more difficult to burn, and a wood fire must first be built under the coal so as to bring it to the burning temperature before it will ignite. It is also known that the different varieties of coal burn with different degrees of ease, soft coal burning more easily than hard coal. All burning is simply a rapid union of the carbon and the hydrogen and the various other elements, as they exist in the combustible, with the oxygen of the atmosphere. The products of ordinary combustion are water vapor and carbon dioxide, when the combustion is complete, with more or less carbon monoxide in place of some of the dioxide, when it is incomplete.

Coal is the product of the partial oxidation of vegetable matter under great pressure and in the absence of sufficient air to cause its complete destruction—a process extending over a period of a million years or more. According to the duration of this process, various kinds of coal were evolved. Thus the oldest form of coal is called anthracite, a product in which there is practically no volatile matter, almost all the combustible matter being in the form of a hard, compact mass, fixed carbon. Anthracite is sometimes called stone coal because of its hardness and difficulty of ignition. It is the coal that gives very little or practically no smoke on burning. That is why it is used in domestic furnaces in cities for heating purposes and in making hot water.

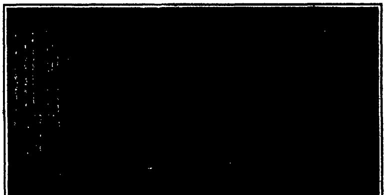
As the age of the coal decreases, it becomes softer and richer in volatile constituents which produce smoke when it is burned. There are various intermediate grades. There is a semi anthracite coal, found in comparatively large amounts in this country, and almost as useful for domestic use as anthracite. Then there are the semi bituminous coals, the bituminous and the subbituminous coals. The bituminous class is the most important of all for these are the coals of industry. The coal that is used for gas making (gas or coking coal) belongs to this class. A still younger coal is lignite, or brown coal. It is a substance that has not been subjected to so complete a decomposition as real coal, and hence it does not possess the heating value of the latter. Finally, there are the peat coals, which contain very high percentages of moisture, and which are not of any great technical or industrial importance. From a standpoint of usage they were probably the first coals used, as they are found so close to the surface that no extensive mining operations are required to render them available.

Coal is found everywhere. The United States contains vast deposits. Anthracite coal is mined mostly in Pennsylvania and West Virginia. Bituminous coals are found mostly in the Appalachian region, which is the greatest storehouse of high grade coals in the world. There are estimated to be three and a half billion tons of bituminous coals within 3000 feet of the surface in the entire country, and of this total, half a billion tons are found in that section. There are also large deposits of soft coal in the West. Lignite coal to the extent of one billion tons is found in North Dakota, Texas and Arkansas.

Wood is also a solid fuel, but it does not possess any great industrial importance. The only other solid industrial fuel of commercial significance, besides the coals and the artificially prepared products that are made from coal dust and tars, known as briquetted fuels, is coke. Coke is a product that is obtained when coal is distilled to produce gas, ammonia, tars and other products. Coke burns almost like hard coal. It is suitable for domestic use under the proper conditions and is also valuable as an industrial fuel, besides its application in a particular form, known as metallurgical coke, in the manufacture of steel. Coke is preferable to soft coal, for in burning soft coal it is very difficult to obtain complete combustion. This fact can be substantiated by observing the condition of the chimneys or stacks in any plant or building in which soft coal is being burned. The clouds of smoke emerging therefrom are a clear indication that a good percentage of the coal, as much as 10 per cent or more, is being discharged into the atmosphere in an unburned condition. Coke burns without smoke, the smoke and other products which are developed in the burning of soft coal in the furnace, and are thereby completely lost, are conserved and employed to useful purposes when the soft coal is first converted into coke in the by-product coke oven. In former days coke was made in beehive ovens and these valuable by-products were wasted. Today there is almost four times as much coke manufactured in the by-product oven as in the beehive oven, and great quantities of gas and other valuable by-products are recovered.

There was a time when by far the larger part of our fuel was solid, and anything else was more or less of a freak. Today liquid and gaseous fuels play a large rôle. The principal liquid fuel is gas oil. This is used in the manufacture of gas, to bring up the heating value of the gas, distilled from coal, so that it meets legal specifications. Crude petroleum is also used as a fuel. Naval vessels and the merchant marine ships use fuel oil in preference to soft coal, for it can be stored more conveniently and burned with a greater degree of ease and efficiency under the steam boiler. Fuel oil is also being used in firing domestic furnaces. In using fuel oil, it is necessary to employ storage tanks and pumping, atomizing and air-mixing apparatus. The price of gas oil and of crude oil as well depends on the demand for gasoline, which is ever increasing. One factor that has a material effect on the quantity of gas oil available for sale is the development that has been taking place in the production of gasoline by the cracking of the higher-boiling-point constituents of petroleum. The newest improvement along these lines is a process of cracking oil which will give a yield of gasoline as high as 80 per cent.

The gaseous fuels comprise not only the gas that is used in the modern kitchen, but also the various modifications of gas that are used in industrial processes, such as producer gas in steel manufacture, oil gas for small lighting installations, etc. We are concerned primarily with coal gas or water gas, which may be summarised under the one heading, city gas. Both are made from coal—the former by distillation of the coal in absence of air and the latter by blowing steam through a bed of incandescent coal or coke. Neither has the high calorific power that is demanded by law in most states, and hence gas oil must be cracked and the gaseous products mixed with them in order to make a mixed gas of 500 or 600 B.t.u. per cubic foot.



Making gas: The charging machine in a horizontal retort house

In considering gas as a fuel there are a number of fundamental principles which must be explained before a clear understanding of its value can be had. When any combustible burns, it is first transformed into gas and then the gaseous products are burned. This is an undeniable fact and can be proven to anyone's satisfaction by a simple experiment.

A piece of paper is rolled up tightly in the form of a tube. One end is closed by folding over the paper and a small hole is made in the tube near that end. The other end is open to the air and the paper is set fire to at that end. If the paper is held so that the smoke travels up the tube, as the latter issues forth from the opening at the closed end, it can be ignited and burned.

It stands to reason that if a fuel is first gasified before it is burned, the most efficient gasification will result in the greatest fuel economy Each stove or furnace or any other apparatus that burns coal or coke is primarily a gas producer. The efficiency of such a producer must necessarily be low, and far below that of the gas-making apparatus used in the modern gas plant. In other words, from the standpoint of strict fuel economy, it is far more logical and more economical to make the gas first under perfectly controlled conditions and technical supervision of the highest order and then burn the gas as fuel, than to burn the coal, from which gas is or may be made, directly in the grate

The carbonization or distillation of coal to give gas yields other products as well which are of the highest importance in industry. These products—benzol, sulfate of ammonia, oils and tars, coke or coky matter—are produced in even larger amounts when the process is carried out at low temperatures. The most recent development along these lines has been the carbonization of coal, arranged on shallow cast iron plates, which form part of a conveying system, and are led over a bath of molten lead in a suitable furnace. The process is known as the Caracristi process and is being installed in one of the Ford plants. It is claimed that the yield is from 7000 to 8000 cubic feet of 600 to 700 B t.u. gas per ton of coal, five gallons of motor spirit, twenty pounds of sulfate of ammonia, 25 to 30 gallons of low temperature oils and about 70 per cent of a sort of coke possessing a good fuel value. The process is important because it tends to conserve the by-products, which are ever increasing in importance.

It is possible to demonstrate by making a careful examination and study of the conditions surrounding the burning of soft coal, coke or anthracite coal and gas, that of these fuels gas can be burned with the greatest thermal efficiency Coke or anthracite coal may be burned with an efficiency of 60 to 65 per cent, soft coal with that of 55 to 60 per cent and gas with an over-all efficiency of 90 per cent.

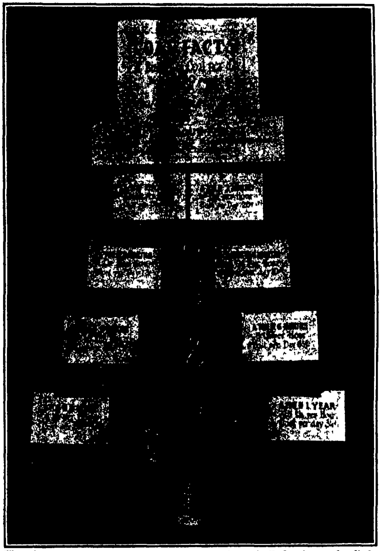
If gas can be burned so economically, why, then, is it not used in preference to the other fuels? There are other advantages in the use of gas besides greater thermal efficiency. Any householder who has used gas in heating his home can testify that it is much more convenient to fire with gas than with coal, there are no ashes to be removed, the control of the furnace is much simpler and far more effective, the house can be kept at more uniform temperature, and heat is not wasted by banking fires in warm spells during the heating season. It would appear that there should be no hesitancy at all on the part of the house owner or the factory manager to substitute gas for coal. But there is one—the higher price of the gas.

Gas today is being used for heating houses and as a fuel in many industrial plants. Its use is ever increasing for these purposes, and it finds no difficulty in entering the field, as a universal fuel, once the price disability is removed. In various industrial cities and towns throughout the country gas is being employed for many and in fact all purposes for which coal was used before. When the gas rate is adjusted to conform with local conditions—and it must be remembered that it is not equitable to compare the circumstances which caused a lowering in the gas rate in one city or state with those that entail a higher rate in another state or town, for each case is individual and necessitates different treatment—then there will remain no reason for not using gas in preference to other fuels, which compete more successfully.

The gas rate remains high in certain localities chiefly because legal regulations make it incumbent on the gas company to furnish gas with a high heat value This means that the gas company must use high-priced raw materials in manufacturing gas, which bring up the price of the manufactured product. Gas can be made just as well from lower-priced coals, and gas oil need not be used to enrich the gas if a low heating value, say, 300 to 400 B.t.u. per cubic foot, instead of 550 or 600 B t.u. per cubic foot, is permissible. It is a fact, substantiated by tests conducted by the Bureau of Standards in Washington and confirmed by experiments made before engineers of Public Service Commissions and gas experts, that there is very little difference in the efficiency of burning high- and low-heating value gas. It is not necessary to mass a great concentration of heat units in a gas in order to obtain high combustion efficiency Furthermore, it has been found by actual experience with the low heating-value gas that a great saving in gas bills is effected by its use, for the consumer seems to be able to obtain the same good results with the same quantity of the low-heating value gas as with the high This seems paradoxical, but is proven by actual experiment under operating conditions to be correct

Recently a momentous decision was made by the Colorado Public Service Commission in allowing each gas company within its jurisdiction to make gas of any quality that it finds to be best both economically and technically The price is then adjusted according to the cost of manufacture and the cost of service. The consumer benefits directly, for he gets a cheaper gas, which enables him to use it for purposes which were heretofore exclusively the field of coal The gas company benefits, for its business is enlarged and extended to new fields. The impetus toward the attainment of this condition must be given by the legal authorities in removing the disability that holds back the gas industry from performing its real function to society—a disability inherited from a day when the service rendered by gas was totally different from what it is now

Gas can become the universal fuel It possesses all the requisites of universality of usage It represents the one logical solution of the fuel problem When it replaces the use of coal and other fuels once for always in industry and in the home, we may say that a condition of maximum fuel economy will have been reached, the fuel situation will have been put on a sound economic, technical and political basis.



Though the coal money is spent all at once, it is used all the time and a little at a time The above graphic statement may help the coal user to realize that his fire costs money every time he puts a shovel of coal upon it

The Laws of Vision and the Technique of Art

IN an interesting paper published under the auspices of the Rumford Fund in the February issue of the Proceedings of the American Academy, Messrs. A Ames and C A Proctor and Miss Blanche Ames discuss the theory suggested by Birge Harrison, that a picture is most artistic when it reproduces our retinal impressions. The retinal picture is less distinct at the edges than at the center and is distorted in the "barrel" manner, while the retina itself is more sensitive to blue near the edge than at the center When a photograph of a landscape or building taken with a camera having a lens with the same properties as the eye is compared with one taken with a corrected lens, that taken with the artificial eye produces the more artistic effect On examining a number of pictures by distinguished artists, the authors have found evidence of the conscious or unconscious use by da Vinci, Rembrandt, Israels, Millet, Turner, Whistler, DeHoogh, and others, and by one living artist Orpen—of the technique suggested by these laws of vision The authors urge that the retinal picture should be made the basis of the technique of art

The Deepest Mines

BRAZIL still contains the mine that goes the deepest below the surface of the earth, although the deepest below sea level and the nearest therefore to the center of the earth is in the United States.

The deepest hole in the earth is a gold mine in the state of Minas Geraes and is known as the Morro Velho or St John del Rey mine It is owned by the St John del Rey Mining Company, an English corporation, which has been working it almost continuously since 1834

The mine is now 6,726 feet below the surface at the top of the shaft through which it is entered The next deepest mine is in the Kolar gold field of India, where one shaft descends to 6,140 feet The Village Deep mine in South Africa goes to 6,100 feet The deepest in the United States is Tamarack No 5, a copper mine in the Lake Superior region, with a depth of 5,308 feet The bottom of this shaft is 4,100 feet below the level of the sea, while that of the St John del Rey is only 3,958 feet below sea level, since the mouth of the shaft is in a mountain country 2,768 feet above sea level The Tamarack mine goes nearest to the center of the earth

The temperature of the rock at the lowest level of the St John del Rey mine is 117 degrees. The miners work in an air temperature of 98 degrees. The outside air has an average temperature of 68 degrees but is cooled to 42 degrees before being forced to the lowest levels from which it is drawn to the surface by powerful fans. On its way to the lowest depths it gains heat from the rocks and from its own compression, because air at that great depth is considerably denser than air at sea level

The mine is a dry one, there being no water at the lower levels, and because of the low relative humidity of the air which has been dried before being forced into the mine, the men are able to work under satisfactory conditions.

The St John del Rey mine is not only the deepest mine in the world but is operated by the oldest registered English mining company, organized in 1830 to work a mine at a place some distance from the present workings. This mine proved to be unprofitable and in 1837 operations were transferred to the present site where they have since been carried on almost continuously

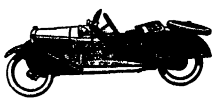
The deepest hole in the bedrock foundation of the crust of the earth has been recently reported to have been drilled in South Africa It is not the deepest from the surface but the point is that its 5,300 feet of depth is all in the pre-Cambrian strata, the underlying rocks which were laid down and finished some hundred million or so years ago. The other deep bores mentioned above are in rocks of more recent formation, or even, especially in the case of the Tamarack shaft, in superposed sedimentary material —*Abstract from recent address by Dr T T Read, U S Bureau of Mines, before the N Y Section of the American Institute of Mining and Metallurgical Engineers*

Three Wheels Versus Four

The Direction in Which the Development of the Economy Car is Pointed

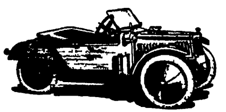
By R. M. Sanders

IN EVERY man's inner self from childhood days onward lies the desire to own a means to locomotion Yesterday it was a horse and carriage, or maybe a saddle horse, and today an automotive vehicle of some description. Millions of automobiles have been produced, and still there are more people walking than riding Many people are in a position to purchase automobiles, so far as the original cost is concerned, but the fundamental thing is the small income earner cannot afford to operate even the lowest priced automobile on the market today People therefore have become motorcycle and sidecar owners.



The motorcycle and sidecar combination is very economical to operate. We can easily realize this when it is possible to get from 40 to 50 miles per gallon of gasoline and 2000 to 2500 miles per gallon of lubricating oil Then, again, there are but three tires against four on the automobile, without considering the fact that these tires carry less weight per tire than the automobile The question of garage rent enters into the cost of those who reside in the city or town and do not own their own garages. The lowest rent per month for the smallest automobiles is approximately \$15 to \$20, against the motorcycle and sidecar combination of \$4 to \$5 per month It is readily seen from the above figures that the cost of operation of the motorcycle combination is far less than operating a small automobile The wear and tear (cost of replacement parts) is also in favor of the "combination," due to the fewer wearing parts on same

To satisfy that "inner self desire" of owning an automotive vehicle, and yet to be able to operate one within their income without sacrificing other necessities, many people have purchased "combinations" in order to get out on the highways and byways of the country though it must be said that many purchase "solo" machines (motorcycles) from a sporting viewpoint Unfortunately, after acquiring a "combination" we find that ordinary every day clothing is unsuitable for all-day traveling on this type of vehicle It is found that we must have special clothing or wear the oldest togs one may have. This applies to the guest who rides in the sidecar as well as the driver, but this is ordinarily considered trivial when you have the will and the desire to "see America first"



A boon to small income earners would be in their ability to purchase a three-wheeler, such as is being manufactured abroad A three-wheeler is a light car (if you care to call it that), light in weight particularly It is called a three-wheeler abroad by virtue of the fact that it has but three wheels. The same number as a motorcycle and sidecar, but of much different design and arrangement

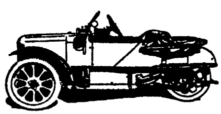
The outstanding advantage of the three-wheeler over its predecessor, the motorcycle-and sidecar combination, is its comforts. The three-wheeler has a full seat upholstered the same as an automobile and wide enough to accommodate two people comfortably side by side The body as may be noted from the illustrations, is built along automobile lines. The springs of some of the three-wheelers abroad are of the half-cantilever type both front and rear Naturally, the comfort of riding in a three-wheeler on a well sprung chassis and in a roomy body is incomparable to the "combination" The driver of a "combination," usually the owner has none of the comforts that his guest enjoys riding in the well sprung and luxuriously fitted sidecar In the three-wheeler both riders are equally comfortable

Anyone who has experienced the displeasure of being suddenly overtaken by a rainstorm while driving on a motorcycle and sidecar will readily see the advantage the three-wheeler has over the combination The sidecar is usually fitted with a windshield and top, but is it fair to the owner-rider to be seated out in the open, subject to ravages of the elements? It is possible, of course, to keep comparatively dry on a motorcycle if the rider dresses like a deep-sea diver but who wants to do that? As it is, one has to wear old clothes or purchase special clothing. Whereas, when driving a three-wheeler, one can put on "Sunday-go-to-meeting" clothes and still enjoy the open country Then, if bad weather is encountered, both riders have equal protection from the elements.

Sociability is a strong point in the favor of the three-wheeler, for it must be admitted by the most enthusiastic "combination" owner that it is exceedingly difficult to carry on a conversation with the fair rider of the sidecar The fact that both the driver and the passenger are afforded equal protection from the elements and are seated side by side tends to make the longest journey a pleasure under the worst conditions in a three-wheeler

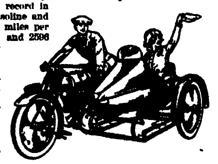
Riders of three-wheelers are never conspicuous through difference in dress when attending a gathering or at the theater, for they are able to ride to these various places without the necessity of changing their clothing upon arrival, whereas the "combination" rider has to

The components used in the construction of the three-wheelers are similar to those of the motorcycle. The engines used are mostly V types, of the same cubic displacement and general design, the only variation being in the placing of the clutch at the engine instead of at the transmission The cooling systems of the engines used abroad are equally divided between the water-cooled and air-cooled V engines The clutch of the three-wheeler and the motorcycle are of the same size in area and capacity, for both engines are of the same displacement The transmissions have approximately the same number of gears, though three-wheelers are equipped with three-speed gear boxes, two speeds forward and one reverse, whereas the motorcycle has forward speeds only



The final drive is exactly the same as a motorcycle, as both drive via roller chain to a single rear wheel The brakes are also similarly located and actuated, one contracting and one expanding, acting on the rear wheel Some of the three-wheelers are fitted with front-wheel brakes as well.

Let us now make a comparison of the cost of operation between the three-wheeler and the motorcycle and sidecar Abroad the initial investment in either machines is approximately the same Inasmuch as we have the same engine size, same number of wheels, same load and weight to carry it is logical that the cost of operating the three-wheeler is no more than the motorcycle combination. It has, in fact, been proven abroad that the cost of operating is less than the average motorcycle combination The three-wheeler holds a record in England for economy both in gasoline and in oil—gas consumption of 67.1 miles per gallon (British Imperial gallon) and 2596 miles per gallon of oil Tire wear also is less than with the "combination" So, with increased utility and less cost per mile, the three-wheeler is the most economical vehicle to operate



When taking a general view of the three-wheeler from an engineering standpoint, we find that it consists merely of a rearrangement of the components to make use of the maximum power available to produce the greatest results.

In comparing the power application of both vehicles, let us suppose for example that we have a box to move. It is most likely that we would push at a point in the center of the rear of the box, to move it forward with the minimum of effort. It is quite evident that we would not push on one of the corners and expect it to move forward without also using some additional effort to keep it in a straight path.

The foregoing paragraph illustrates the improper application of power to a vehicle having three wheels, when the power wheel tracks directly behind and in the path of another wheel Therefore, the arrangement of the wheels as used in the three-wheelers should be two wheels in front (used for steering), with power wheel placed directly behind the load to be carried and on the centerline drawn between the two front wheels. By so placing the driving wheel directly behind the load, instead of on the corner of the load, we have applied the maximum power available at the wheel which is in the most effective place. We have no lost power due to the tendency of a vehicle to move in a diagonal, as illustrated with the box. The "combination" has a tendency to turn around the sidecar wheel when the vehicle is moving in a straight line. This tendency of turning necessitates the holding of the front wheel of the motorcycle over in the opposite direction to overcome this tendency, thereby causing undue wear in the front tire of same Naturally, this tire wears more than it would if it could travel in a straight line with the rear wheel of the motorcycle Again the three-wheeler scores.

Although the three-wheeler weighs slightly more than the "combination," from an engineering standpoint it is exceedingly far in advance of the motorcycle and sidecar with a given useful load and available horsepower Therefore, it is not only logical, but it has been proven, that the three-wheeler is more efficient than the "combination."

The three-wheeler was made on a small-scale production in 1910 and first exhibited at the Olympia (English auto-show) that year The pioneer firm is still going strong and its product has increased in demand as the three-wheeler industry grew There are today in Europe seven manufacturers of the three-wheeler, which is a proven vehicle abroad There has been very little change in general design during the past ten years. The important automotive developments in reference to engines and other components have been adapted to the components of this vehicle as well as the other automotive vehicles. Abroad we find that most manufacturers of three-wheelers and motorcycles purchase their engines, transmissions and other components from parts manufacturers. The same conditions prevail as in our automobile field, which has proven so successful through the standardization work of the Society of Automotive Engineers. It was only natural that parts manufacturers should play an important part in three-wheeler progress.

The three-wheeler, in competition with the motorcycle combination and four-wheelers, has won more than 23 gold medals and 15 silver medals in meets. This includes speedways, hill climbs, road races, of both stock machines (driven by owner-drivers) and factory machines. They hold the economy record of 67.1 miles per gallon, also the speed record for one mile of 82.2 miles per hour. In Britain and on the Continent, many general competitions are open to them, and many more provide a special classification for them The European automobile journals give them a place which, to one not familiar with their development, would seem altogether out of proportion to their importance, and correspondence columns indicate a very lively interest on the part of the readers in this type and its future. Distinctly it ranks as a small car and not at all as a motorcycle, both in England and on the Continent

The three-wheeler has a definite place to fill. It will ultimately replace the motorcycle and side-car, which is a compromise and a very poor compromise at that. The public has never demanded any new machine before it was displayed and demonstrated. Once the three-wheeler is introduced in this country to the public, it will be possible for the small-income earner to satisfy

that "innermost" desire to own and operate an automotive vehicle. There are many people in this class to whom the "combination" appears dangerous and mysterious, due largely to the exposed units and necessity for special clothing. It may be predicted that the three-wheeler will recruit many more enthusiasts than the "combination," including a large percentage of the present "combination" owners.

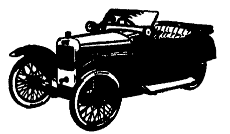
The three-wheeler has one outstanding advantage which the motorcycle, with or without the side-car, can never meet. It can carry a battery and self-starter, and it has the reverse speed in its gear box. The absence of these makes the motorcycle fundamentally unsuited for general use by all members of the family but the three-wheeler is just as easily started and just as easily maneuvered out of a tight spot by the weakest member as by the strongest.

Gelatine to Eat and Gelatine for Glue

IN our October issue, in his article on curious foreign foods, Mr L. Lodian permitted his appreciation of a time-honored jest to run away with his discretion and to blind him to facts. Mr Lodian, in speaking of Delft gelatine refers to "the well-stewed viscera of old hoss" as the raw material from which this product is made. As anybody familiar with our pure-food laws would realize, such a concoction as he pictures would be quite unable to get past our customs as a food product. The fact is, as the leading importer of this substance points out to us, there are two grades of gelatine, one being for food and the other for glue in Delft, as everywhere else, the two are kept quite apart, and one can eat Delft gelatine, or any other edible gelatine, without concern as to its origin. It is a matter of regret to the SCIENTIFIC AMERICAN that Mr Lodian, in a vein of misdirected humor, should have made a statement implying otherwise, and that this statement should have slipped past the editorial blue-pencil.

Trackless Trolley Details

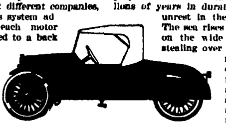
THE use of trolley buses in European countries has been covered in a very comprehensive way by Mr H. L. Andrews, Railway and Traction Engineering Department, General Electric Company, who points out that European countries have for a great many years successfully operated trackless trolleys. In 1920 there were in England twenty companies with more than 100 miles of trackless trolley installations operating or authorized, while Italy had eight companies, comprising a total of 43.5 miles of route, and Germany had eight installations for passenger and freight traffic. France, Sweden and Austria have a number of installations in successful operation There are in use in Europe three general systems—1st, Mercedes Stoll, 2nd, Filovia, 3rd, Max Schiemann—all of which differ in the method of drive and in the method of collecting current.



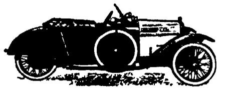
The Mercedes Stoll system is essentially a four-wheel drive, although two-wheel drive installations have been made The driving motor is built into and is a part of the driving wheel. The control is arranged to give six speeds and three electric brake positions. When used with two-wheel drive the motors are connected in series for the first three points and in parallel for the last three positions. The arrangement for the four-wheel drive differs from the two-wheel drive only in having the two front-wheel or the two back-wheel motors connected in series. The collector used with the Mercedes Stoll system is of the overrunning or carriage type. The current collector at the trolley end is composed of a frame having two small grooved wheels with ball bearings on each side, one pair running on each wire. A cable with a double wire hangs down from the center of this frame or trolley and has a weighted pendulum which keeps the wheels well pressed down on the wires. This collector allows considerable movement from the trolley wire, and extreme movement is taken care of by means of a cable and reel on the car which allows 30 or 35 feet radius from the center of the trolley When vehicles operating in opposite directions meet, the drivers exchange collectors and plugs, which are readily detachable and within easy reach

For the most part these trackless trolleys weigh approximately 6048 pounds, less load, and have a seating capacity of 25. In some few installations larger cars weighing over 11,000 pounds complete are used. One installation is equipped to handle motor car and trailer cars, the motor cars having a seating capacity of 22 and the trailer cars of 20.

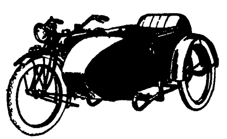
The Filovia system, which is in operation on more than 40 miles of route with eight different companies, has proved very successful This system adheres to a two-motor drive each motor mounted on the chassis and geared to a back shaft on which is mounted a sprocket wheel Transmission of power to the rear wheels is by means of a chain drive Each car is equipped with two 12-horsepower motors. The collectors used are similar to those described with the Mercedes Stoll system, except they are connected to the bus proper by means of a rigid pole.



The Max Schiemann system has been employed extensively in Germany for both passenger and freight service There are eight or more installations, three of which are strictly passenger service, four are entirely for freight and one handles both freight and passengers. This system uses a two-motor drive, each motor being mounted on the truck chassis and geared to a back shaft by means of bevel gears Power is transmitted to the rear wheels by a chain drive Three methods of collecting current are used with this system 1st two trolley poles under running on the trolley wire 2nd, one trolley pole with a double head carrying two trolley wheels, 3rd overrunning carriage as described under the Mercedes Stoll system This last method of collecting current has not produced good results, due to the damage result ing from the carriage's leaving the trolley wire



English practice differs somewhat from any of the three systems previously described. Two motors are used, each being mounted on the truck chassis and connected to a jack shaft through worm gearing The jack shaft carries a sprocket wheel and power is transmitted to the driving wheels by means of chain drive This practice of using two motors and the method of operation have been changed somewhat in the more recent installations, particularly the one in Shanghai, China On these buses two motors are used, mounted directly on the chassis, but the jack shaft and chain gearing are omitted, the motors being connected direct to the driving axle, using worm gearing, each motor driving one of the rear wheels.



English operators who have used the gasoline-propelled bus more extensively than we have until recently in this country, both independent of their railway systems and as feeders to their established lines, have stated that the gasoline propelled bus, so far as it has been developed, cannot be operated at the same cost as the street car, and that they are not well adapted for handling peak loads, but they have found the gasoline bus well suited to operate as feeders or to connect up existing street railway routes. The Paris transportation system is now operating trolley buses in extension of trolley lines in rapidly growing suburban sections In the United States and Canada recent installations have been made at Staten Island New York City, Baltimore Md. Richmond, Va , Minneapolis Minn , Los Angeles, Cal , Toronto and Windsor, Ontario

World Revolutions

THE land surface of the globe has been, for the most part many times covered by the sea in the course of geological time The mountain ranges of the earth, as now known, have only recently attained their present elevation, other mountain ranges formerly existed which have now been all but obliterated by the remorseless effects of long-continued denudation.

It is important that we should study for a little what happens when a great mountain range is developed on the surface of the globe There is a long period of preparation for the stately event, a period many millions of years in duration First, there are signs of unrest in the solid land of the continents. The sea rises on the coasts and transgresses on the wide lands within, very gradually stealing over the lower levels. This process may not be steady and continuous. There may be periods of retreat followed by periods of advance, but always the land as a whole goes on sinking deeper and deeper into the sea Many millions of square miles may be covered with the shallow seas—perhaps to a depth of two or more hundred fathoms—so that a considerable portion of the land area of the globe may become sea before the downward movement ceases. This transgression is a slow process so slow and long-enduring that, while the submergence lasts, great depths of sediment accumulate in the transgressional seas.

Then at length there comes a resurrection The land begins to emerge, but not the old land which went down Where the great accumulations of sediment had been, mountain ranges arise In short, what arises from the ocean grave is a crushed and wrinkled world, shattered by faults and over thrusts and exhibiting every evidence of great horizontal compression One attendant of these events is the outbreak of volcanoes and floods of lava welling out of fissures in the earth's crust The latter generally appear along western coasts, or to the west of the new born mountain ranges.

These events draw to a close when the land has attained its former elevation more or less There is then a new era of geological history a long era of organic process, lasting many millions of years, during which minor oscillations of the crust and local deformation may occur This is a period of active denudation The last born mountains are degraded by denudation, and their sediments collected into the great troughs or geosynclines, and the sublime but unreasoning sequence of events is repeated all over again

Such has been in leisurely repetition the history of the earth Certain world revolutions are generally accepted—although geologists are not all agreed as to their number—as comprised in the period of 150 or 170 million years which the statistics of denudation and the record of thorium lead ascribe to the age of our era Four or five world revolutions appear to enter into that time interval Thus 30 or more millions of years may, tentatively, be ascribed to the genesis and consummation of a world-revolution —*From an address by Prof J Joly, F R S, before the Royal Dublin Society*

The Relation of Suicide to Climatic and Other Factors

IN A recent number of the *American Journal of Hygiene*, Dr J R Miner presents the results of an extensive statistical analysis of the relation of suicide to climatic and racial factors, and to industrialism, occupation urban conditions, age, and sex It has long been recognized that the suicide rate is higher among the Nordic race than among Alpine or Mediterranean peoples. Mixed peoples usually have a higher rate than either of the pure races to which they belong Foreigners in New York show a higher suicide rate than in the countries from which they came The lowest rate is found in Ireland and the highest in Saxony, while the rate varies in different parts of France according to the racial composition of the population. Among Asiatic peoples, the Japanese and Chinese rates are high, while in India it is low (4 8 per 100 000) India appears to be the only country where female suicides exceed the male The general trend of suicide rates has been upward during the last century but the higher rates tend to become stabilized Germany France, Denmark and Sweden have high rates Britain, Norway and the Netherlands low rates. In the United States the rates are lowest in the south and highest in the west.

Our Point of View

Radio in the Frozen North

RADIO, among other accomplishments, has robbed present-day arctic exploration of much of its former terrors. It has done away with the dreaded isolation that formerly went with such a venture. Men no longer pass out of touch with us once they leave behind them the northern outposts of civilization, for while they may be engulfed by the icy wastes of the arctic wilderness, the long arm of radio reaches out to give them courage and cheer

Last March a dinner was in progress in honor of Dr Donald B MacMillan, the famous arctic explorer Several naval officers were present. Dr MacMillan, in the course of a little dinner talk, made the following significant statement

"You naval men and yachtsmen have not the slightest idea of what the real hardship of the North is It is not the lack of food, because I have proven that we can live for three years or indefinitely, on the food of the Eskimo It is not the cold, because we have proven that if we eat and dress as the Eskimo does, we can stand as much cold as he. It is the solitude—everything going out and nothing coming in No one to talk to besides our own party of seven men except a few unimaginative Eskimos, who grow very tiresome Arctic explorers have in the past been forced to shoot their own men because of insanity brought on by the solitude"

At this point Dr MacMillan was asked why he did not take an efficient radio apparatus with him, and his answer was "In my 87 foot boat space is so valuable that we could not afford to give up the room necessary" Yet on his past expedition he took a small radio set requiring very little room, which radio set proved ineffective. So Dr MacMillan was asked "Well, doctor, fully 50 per cent of your space in the hold of your ship is given to food which you tell us you can do without Why not give up some of that space to overcome the real hardship of the North?" His answer was to the effect that he had never looked at the question from that angle Subsequently, and in preparation for his present expedition, the explorer gave up not the space in his hold but two very valuable berths in the forward end of the fore-castle of his schooner "Bowdoin," to a powerful transmitter so that he might keep in touch with civilization

And so our intrepid arctic explorer of today is keeping in touch with us from his frozen berth in the arctic wilderness. Dr MacMillan's messages are coming back at frequent intervals, even though he is now frozen in for the winter at Refuge Harbor on the northwest coast of Greenland, within 11 degrees of the North Pole When it was first announced that he was to take both radio receiving and sending apparatus into the arctic, many engineers and scientists said that he would never be able to penetrate the curtain of the auroral band with radio messages. This has been disproved. When Dr MacMillan first arrived inside the auroral band it was difficult to get messages back because of the fact that he was on 24 hours daylight, but now that he has a period of darkness the messages are coming back with great regularity The American Radio Relay League, composed of the amateurs of the United States and Canada, sent Mr Donald Mix, an expert radio operator, with the MacMillan expedition, and all the amateurs are standing by nightly in their endeavors to hear MacMillan.

So much for the "going out" part of radio. But how about the "coming in" part? That is the feature which combats the worst terror of arctic exploration—solitude

Simple enough. Our broadcasting stations take care of the arctic explorers. Each Wednesday evening at midnight, Central Standard Time, we talk to Dr. MacMillan from the Zenith Edgewater Beach Hotel broadcasting station, WJAZ, and give him not only a résumé of the week's news, but also the messages from his friends and relatives and from the friends and relatives of his crew of seven men. And this takes place in the spoken word, please note, and not the awkward and slow dot-dash code of the radio telegraph Aside from this personal service, MacMillan and his men are enjoying radio programs to the utmost—music, talks, sporting events, and so on. Where is the solitude of the far North?

The Laborer and His Hire

IN THE series which has now come to carry the title "Psychic Adventures," the articles describing Mr Bird's experiences with Messrs. Sloan, Powell and Hope placed emphasis upon the claim that these mediums do not profit financially from their mediumship. In advancing this claim, we were merely repeating what had been told Mr Bird, in London, by persons who were in a position to know the facts.

Since the appearance of the articles in question, we have heard from Mrs. McKenzie, of the British College of Psychic Science. It is through Mrs. McKenzie that financial arrangements with these and other mediums are made, and when she speaks, we may substitute, for the belief that she "ought to know" what she is talking about, the positive assurance that she does know The facts, according to Mrs. McKenzie, are not quite so simple as they had been made to appear by those eager to put the mediums in the most favorable light possible.

Mr Sloan, so long as he remained in Glasgow, literally received not a penny for his mediumship When he came to London, however, employment was found for him at common labor, paying him ninety shillings per week—well above the prevailing scale for such work, and in addition, from College funds, one pound per week was laid aside for him against emergency

Mr Powell gives many sittings to his friends, either with no charge or with the mere remission of his expenses. But when he comes to London, he leaves his business for a week at a time, and it is at once proper and necessary that he receive compensation for this. Mrs. McKenzie does not speak in pounds and shillings here, but she characterizes the fee which Mr Powell receives for his monthly appearance at the College as "handsome"

Mr Hope *has* calculated what he could earn at the carpenter's bench in the time occupied by a photographic seance, and *has* fixed a charge accordingly But this charge applies only to those who go to him at Crewe, and even then, many sitters give him a ten shilling note or even a guinea and insist upon having no change When he comes to London, the same situation exists, to less degree, as with Powell, and he gets enough to justify the trip.

The spiritualists who in argument slide over and even falsify these facts, do so with no realization that they are misrepresenting They are firmly convinced of the good faith of their mediums, and are impressed with the large spiritual satisfaction which the seance gives for a comparatively small return Feeling so strongly that the medium gives more than he gets, they rush to his defense when the implication is made that he works for money And they defend him not wisely, but too well

Sloan while in London derived, Powell and Hope habitually derive, no small part of their livelihood from their mediumship. Our spiritualistic friends would do far better to face this fact than to seek to explain it away For the medium devotes a very considerable part of his time to his mediumship, and in a day when money alone makes the mare go, why should he not receive a fair remuneration for this time?

The condemnation of a medium on the mere ground that he accepts fees, the implication that he should serve without pay, has always impressed us as the height of hypocrisy Of course to the blatant fraud who swindles widows out of their insurance money through "messages" from their deceased husbands these remarks do not apply We speak only of the medium who gives ordinary seances at a fixed or sliding fee and gets no oblique return from his mediumship.

For after all, even a medium must live. Nobody has ever suggested that the doctor ought to have a job, on the side, as carpenter or hack driver, earning his living from this and giving such time as he can spare from it to the gratuitous healing of disease. Nobody has ever argued that the priest or the minister ought to take in washing to support himself, marrying and burying people and healing spiritual sores gratis, between turns at the wringer The medium, to the people he serves, gives just as real a service as does the doctor or the parson to his constituents. Why ask him to give it for nothing?

Unite Atlantic and Pacific Fleets in One

THE American Legion, in Annual Convention in 1922, adopted unanimously the following resolution "We believe that all combatant first-line vessels should be concentrated in one fleet for purposes of better training and more economical administration, further, that this fleet should be based where it can be maintained and administered at the least cost to our government."

Our late President assured us that the Federal Government will have to practice economy for many years to come. This is true of every department of the government, and since the Navy spends annually more than 300 millions of our revenue, it should practice rigid economy and stop only at the point where further reduction of expense would interfere with efficiency

Now, one direction in which a large reduction in expenditure could be secured, is to reunite our present disunited, first line battle fleet. For nearly twenty years before the World War, our first-line battleships were concentrated in a single fleet, based in the Atlantic, but in 1920, apparently for political reasons, Secretary Daniels split the fleet in half, placing part in the Pacific and part in the Atlantic The moving of the more powerful half of our battle fleet into the Pacific, together with Mr Daniels program for building sixteen battleships, produced considerable anxiety in Japan and a counter-building program was started in that country Happily, we have agreed to a 5-3 ratio as regards Japan, with no development of naval bases west of Hawaii, and have signed the Four-Power Treaty for the settlement of any future difficulties in the Pacific. As regards that ocean, our Secretary of State has assured us that there is now not a cloud in the horizon.

There was never any sound military reason for splitting up our battle fleet, naval opinion indeed was all against it. Our ablest strategist, Admiral Mahan, long ago warned the American people against dividing our fleet between the Pacific and Atlantic. He attributed the overwhelming of the Russian fleet by the Japanese largely to the fact that it was divided and each fleet defeated in detail "It is precisely the same," he wrote "in application as well as in principle, with the Atlantic and Pacific coasts of the United States. . . . Concentration protects both coasts, division exposes both."

Concentration makes for efficiency. The larger the fleet, the better training it affords both for officers and men, since the maneuvers are more realistic and simulate more exactly those that would be required in battle. The battle fleet is a team, and team work is essential. How futile it would be if the Harvard football team should train its line in Cambridge and its back field in Pasadena and then bring them together on the day of an important game!

Concentration of the fleet, furthermore, would result in marked economy Our railroads and corporations consolidate to eliminate overhead and reduce expense; our battle fleet must do the same to reach the same end. With the fleets united, fewer admirals with their numerous staffs would be required. There are hospital ships, supply ships, tugs, etc., serving the battle fleet in the Pacific, and identical vessels serving the battle fleet in the Atlantic. Consolidation will eliminate many of these auxiliaries, and make a marked reduc-

Our Point of View

tion in the number of officers and men then required

But where shall the united single fleet be based? Now that the so-called Japanese menace has vanished, there is every reason why the fleet should be based in the Atlantic. Let us consider some of these reasons. In the first place, there are eighteen states bordering the Atlantic, while only three border the Pacific, and those Atlantic states provided in 1920 for the upkeep of the Navy eleven times as much revenue as those on the Pacific seaboard. More than three-quarters of all our states and 92 per cent of the population of the country have a natural outlet on the Atlantic, and they provide 94 per cent of the money spent by the Navy Basing half of our fleet in the Pacific, so far away from the center of population, brings added expense and waste of time in transporting officers and their wives and families out to the Pacific and then back again at the end of their tours of duty Several naval transports are now engaged in this work

Since the industrial centers of the United States are in the east, it follows that most of the ammunition, stores, equipment, etc., are manufactured in the east, and half of these, if the fleet is divided, must make the long and costly transit by sea to the Pacific coast, thereby adding greatly to the expense.

Last, but by no means least important consideration in favor of a single fleet, is the fact that the Atlantic seaboard has had many millions spent on it to develop Navy yards and bases for handling our battle fleet. Today these are all operating at reduced efficiency, with high overhead expense, because most of the work for which they were designed is now being diverted to the West Coast, where plans are on foot to spend millions more of the public's money in developing bases, which can just as well wait until there is more money in the Treasury for such purposes. This is no time to spend millions in building up new Navy yards, when there are ample facilities for handling the whole fleet in the Atlantic.

Hudson River Bridge and the War Department

THE PROTECTION of our rivers and harbors against private encroachment is one of the important duties of the War Department Before any bridge can be thrown across a navigable river or any other kind of waterway, it must receive the sanction of the Army Engineers. It was because of these conditions that a public meeting was held recently in the Army Building, New York, for the purpose of hearing the arguments for and against the great bridge which is proposed across the Hudson River, at or near Fifty-ninth Street It augurs well for the future of this great enterprise that the meeting was crowded, and that some forty letters in approval of the bridge had been received as against three or four against it.

The principal objection, as voiced at the meeting, came from an unexpected quarter and certainly in an unusual form. We refer to the claim of one of the leading trans-Atlantic steamship companies, that, although the bridge was located as far up the river as Fifty-ninth Street, it was yet so far down the river that it might prove to be an obstruction to the maneuvering of the larger ships when they are entering or leaving their piers. It seems that the masts of some of these vessels extend 200 feet into the air, or 50 feet higher than the bottom of the proposed bridge.

To those of us who are familiar with the Hudson River, the location of the piers of the great steamship companies, and the manner in which the biggest ships are swung across the stream and coaxed into their berths, it will seem rather absurd to claim that a bridge which is one-third of a mile distant from the piers could interfere with the docking maneuvers. A capable captain, in making for a pier, does not over-shoot the mark by twice the length of his own ship, and if he should do so he would prove himself to be incompetent and a candidate for reprimand or dismissal. The steamship companies have been generously treated by the city, which now asks that, in return, they shall do nothing to obstruct a great project which aims at the solution of one of the most pressing transportation problems of the city and the Metropolitan District.

The Industrial Fellowship System

WHEN future historians tell the story of the industrial development of the Twentieth Century, if they have a just sense of proportion they will lay due emphasis upon the increasing cooperation between industry and science which has been such an outstanding fact of the past two decades. Our readers will remember the illuminating articles contributed by the late Dr Robert Kennedy Duncan upon the Industrial Fellowship System of which he was the originator This was placed in experimental operation primarily at the University of Kansas in 1907, and it was inaugurated at the University of Pittsburgh in 1911 Two years later, the present Secretary of the Treasury and his brother established the Mellon Institute of Industrial Research on a permanent basis, and their continued financial support has made it possible to bring the system up to its present strong position.

What is the Industrial Fellowship System? Its aim is to promote industrial success through scientific research, that is to say, to find new materials and new processes for industrial development, and to advance manufacturing through the application of scientific methods to industry Its methods of operation are as follows an individual industrialist, a company, or an association of manufacturers, having a suitable problem, or several of them, requiring investigation, may become the donor of an Industrial Fellowship, provided that the problems are of sufficient scope to warrant the services of at least one man for a period of at least one year, and provided, also, that there is no other investigation in process in the Institute on the topic suggested by the prospective donor Thanks to the generosity of Secretary Mellon, the Institution is entirely independent and derives no financial profit from the investigations which it undertakes Therefore, it is in no sense of a commercial nature Furthermore, the executive staff of the Fellowship devotes itself to the interests of the Institute (which, by the way, is a part of the University of Pittsburgh), without outside remuneration

It should be explained here that the donor provides a foundation sum sufficient to cover the annual cost of the Fellowship including operative charges, purchases of all necessary apparatus, and pays the salary of the research man or men selected to work on the particular problem. The Institution on its part selects the Industrial Fellow for the particular investigation which is entrusted to him and to this he devotes his entire time Also, it furnishes laboratory, library and consulative facilities, but all results obtained by the Industrial Fellowship belong exclusively to the donor

Although the results of the investigation are confidential, many of the valuable data obtained are, by the courtesy of the donor, available for publicity and, as our readers are aware, no small part of this material has appeared from time to time in the SCIENTIFIC AMERICAN.

High-Speed Electric Traction

IN A recent issue, under the heading "How fast shall we travel," it was shown that from fifty to sixty miles an hour is the maximum schedule speed on the best appointed railroads here and in Europe. The limiting factor is the length and weight of the trains which are necessary to meet the ever increasing demands of passenger travel. It will be possible to make a considerable increase in the speed of express trains only by reducing their size and passenger capacity To haul a steam train of twelve to fourteen heavy cars at an average speed of from sixty to seventy miles an hour would call for a weight of engine beyond the capacity of our existing tracks, bridges and tunnel clearances.

If the speed of future railroad travel is to be materially increased, it can be done only by the adoption of electric traction and the use of multiple-unit trains. The multiple-unit method permits of a great increase in the total horsepower without exceeding the loading limit for rails, bridges and structures.

The fastest speed ever made on a railroad was achieved some 20 years ago in Germany, on a military railroad between Berlin and Zossen, where some costly experiments were carried on to ascertain how high a speed could be obtained on steam railroads under electric traction, and at what expenditure of power The experimental runs were progressive The speed soon passed the 100 mile per hour mark, and then rose, successively, to 110, 120 and finally to 130 miles per hour The limiting conditions were found to be not in the car but in the track, which proved to be unable to stand up under the severe stresses imposed upon it, and this in spite of the fact that it was specially prepared for these trials.

We are thus brought to the conclusion that schedule speeds of 100 miles an hour can be attained only where the topography is favorable to fairly level and straight lines. Even under these conditions it would be necessary to design a special roadbed and track of costly construction, involving many tunnels, long and costly embankments, the elevation or depression of the tracks through all towns and cities, and the complete elimination of grade crossings Also, the road would have to be equipped with some form of automatic train control, simple, rugged, and absolutely reliable

But when, if ever, such a road were built its cost both for construction and maintenance would be so great that its use would be restricted to those whose purse was deep or who, by reason of emergency, were willing to pay a high price for an extra forty to fifty miles per hour of speed

Thoughts on the Threatened Timber Famine

WHAT WE had to say in our September issue on the possibility of a timber famine has brought to this office a thoughtful letter from Mr James D I Wood, in which he suggests that in considering the world's diminishing supplies, a distinction should be made between coniferous woods and hardwoods, and directs attention to the vast area of hardwoods in the tropics which has yet hardly been touched When the scarcity of coniferous woods becomes so much a fact as to raise the prices of lumber, it will be more profitable, he believes, to take out many of these tropical hardwoods than to attempt to raise the comparatively slow growing hardwoods in our more northerly climate

Then the question is asked, whether it would not be wise to consider conservation under the two separate heads of protecting our watersheds and of carrying on forestry as a paying proposition. The Weeks law and other similar statues afford protection to watersheds and natural parks, but, according to our correspondent, "it yet remains to be demonstrated what policy will best prevent a timber famine," and the work of the Forestry Products Laboratory at Madison, much of which has been described in the SCIENTIFIC AMERICAN, is referred to as giving the country much valuable assistance in forest conservation. The greatest enemy of our forests, the one that does far more damage than the axe of the lumber man, is the annual forest fires. The government is doing much to combat the fire menace. Congress should furnish it with funds to do much more

In his plea for putting the question of timber preservation on a strict business basis, our correspondent asks whether it would not be false economy to plant all waste lands simply because they are waste. It should be done only when it is certain that such lands would yield a profit in return, and the suggestion is made, that because of the more rapid growth of timber in the southern than in the northern central states, it might be more profitable to do our planting in the southern states, even though the freight rates remain high.

Another Mediumistic Failure

Our Committee Sees "Independent Writing" Produced by Substitution of Cards

By J. Malcolm Bird, Secretary to the Committee of Judges

WHILE Sir Arthur Conan Doyle was touring this country last Summer, he met a medium residing in one of our mid-western cities. He had no opportunity for a sitting with her, but she showed him a large quantity of affidavits which had been given her by persons who had sat and been convinced that she was genuine The face value of these documents was such as to impress him strongly, and he brought her mediumship to our attention We communicated with her, and she agreed to come to New York and sit for our Committee

The ornamental material on these pages will have caught the reader's eye and informed him that he is to be told the story of an attempt to produce psychic phenomena through fraud But as we have often emphasized, we are investigating, not mediums, but phenomena The identity of an unsuccessful medium—even of a fraudulent one—is therefore no pertinent part of our story, and we shall withhold this lady's name, as we withheld that of our medium of last May For present purposes she shall be Mrs. Y

Partly through correspondence and partly through personal interview after the medium's arrival in New York, we learned the general character and the procedure of her manifestations. Their classification would be independent writing The messages are produced upon pieces of card or paper, through the apparent instrumentality of flowers, leaves, etc

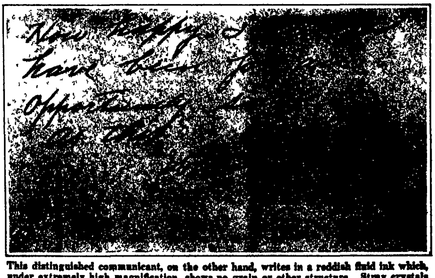
The flowers used must be of colors recognized by the medium as "soft" From them she breaks off a quantity of petals and leaves. For the reception of the mysterious writings she habitually employs index cards of fairly heavy stock, about five by three inches. At a single attack she handles anywhere from a dozen to a hundred or more of these.

The first step is to place the fragments of the flowers among the cards. No attempt is made to get petals or leaves between every two cards, they are merely placed in considerable quantity here and there through the pile When this has been done, the cards, of course, are rather wabbly, and cannot be stacked accurately Mrs. Y takes the pile loosely in her right hand, and the usual procedure is to hold it over the head of some member of the group whom she recognizes as her "opposite' She characterizes herself as magnetic, and requires that the "battery," as she calls the collaborator, shall be "electric" She gravitates toward males in preference to females and toward dark complexions rather than light After holding the cards upon the "battery's" head for an indeterminate period, it is found, to quote her own explanation, that "the coloring matter of the flowers has been precipitated by the psychic operators to form written messages upon the cards' These messages are not, as one might infer from their mode of production done in wide sloppy lines. The effect is entirely that of actual penmanship in colored inks The medium does not profess to understand the details of the process, all she claims to know is the procedure, and the fact that the messages appear

In any attempt at independent writing the identity of the penmanship is always of great interest. Mrs. Y, in response to questions, explained that she has a spirit guide named Effie Effie, if I may borrow from one of the local reporters, is a sort of stenographer of the beyond She has her own characteristic penmanship, and the messages are often in it Sometimes, however, the signature is different, and may or may not be establishable as that of the alleged communicator Mrs. Y, therefore, represents Effie as actually writing to the communicant's dictation, and as sometimes signing the name herself, sometimes leaving that to him Sometimes, however we were told, the entire message is in a penmanship which is presumed to be that of the communicant, sometimes it is distinctly recognizable as that of the battery", and other alternatives occur occasionally Direct personal messages from Effie are often obtained, presumably always in suitable chirography

This "spirit message," from a man whom at the moment the sitters supposed to be living, is in a brilliant gold pigment, which under microscopic examination shows actual metallic crystals

The Editors and Committeemen in advance, and several sitters during the seances, asked the medium where, in the pile of cards, the writings usually came On this point she contradicted herself repeatedly Now she would tell us that the writings appeared only upon cards adjoining flowers, now that they would come on the three or four bottom or top cards, and several times when the cards were examined for possible writings she insisted that the searcher look at every card. These contradictions were repeated so flagrantly from day to day that the attention of the most sympathetic sitters was drawn to them.



This distinguished communicant, on the other hand, writes in a reddish fluid ink which, under extremely high magnification, shows no grain or other structure. Stray crystals of gold here and there indicate that this card was written with the same brush as the one pictured above

If the phenomenon just described occurred genuinely, it would, of course, be one of the most extraordinary of all psychic manifestations. Indeed, it would probably be quite unique, none of our investigators had ever before encountered claims remotely approaching Mrs. Y's. I shall, therefore, make it quite clear, before taking up any of the collateral aspects of the sittings, just how we know that the writings produced in our presence were not genuine.

The first sitting was held in the SCIENTIFIC AMERICAN editorial rooms on October 9th. We had procured the necessary cards from a local stationer A package of 49 of them had been counted out and was turned over to the medium at the beginning of the seance. She tried, with one "battery" or another, for about an hour, and finally confessed failure, expressing confidence of better results next time. Now and again she tore up one or more cards, as soiled. Mr Lehmann at one stage made a mild attempt to take these fragments from her and throw them in the waste basket. It was not at all a determined effort, nor one that Mrs. Y would have had to exert herself to defeat. She did defeat it, retaining the fragments to the end of the sitting, when she handed them to another sitter for destruction

After the medium had gone, the room was thoroughly searched and all fragments of the cards recovered. None of them had been torn into small pieces, and it was possible to patch them all together. When this had been done, we had only 44 cards. Our impressions during the seance had been that if, under the given conditions, the writing as described to us was to be produced *by fraud*, the fraud would necessarily involve the substitution of previously prepared cards. With *our* flowers, *our* cards, and *our* conditions, we were most reluctant to believe that the writing could be actually manufactured, *fraudulently*, in our presence. The disappearance of five cards seemed to confirm this view But we could have no idea whether our own cards were to be substituted back, or whether they were to be used as samples from which other cards would be obtained for this purpose. The former procedure would be the safer, but would be open to the objection that the number of writings which could be produced under it would be limited.

For the second sitting, held in our office on Thursday, the 11th, we had to meet both these possibilities. The medium, on turning over to me the cards that remained after Tuesday's session, had requested that these identical cards be employed on Thursday, since "they would probably have a lot of magnetism left in them" from her handling. After I had rejected a few badly stained ones, there remained 33 cards. These were marked by tiny pin pricks in one corner of each card, and all the cards placed with their marked sides down. The lady, however, whether by accident or because she is a good psychologist, turned the package over in placing it upon her little work table. She sat down at this table and, under pretense of looking for dirty cards, examined the pack. The first four or five cards she scrutinized with an extreme of care quite incompatible with this explanation, then, looking for all the world like a person who had found what she sought, she went through the rest more rapidly, rejecting one or two which were no dirtier than the others. I had no doubt that she had found the pin marks, and the other investigators agreed with me.

While thus examining the cards, Mrs. Y asked me whether the cards *used on Tuesday* had been counted. It was with difficulty that I restrained a smile as I told her yes. She expressed gratification at our thoroughness, and I was highly gratified at hers. During this sitting she again tore up cards, but this time she

tore them so minutely that, within a reasonable time, I couldn't patch them together into whole cards. So I weighed them, and found that the fragments were exactly equivalent to eight cards. Since we had got back 25 whole cards, the account balanced for this seance. I could not avoid the conclusion that the medium had hoped to make this accounting impossible, and thus to destroy our confidence in any accounting which we might think we had made for the previous sitting.

We had anticipated, and indeed had rather hoped, that the pin marks might be found They had served their purpose, for future sittings we had adopted a different plan, and we were very glad to have the medium's attention turned toward such things as pin pricks. Packages of 49 cards had been made up, and sent to the trimmer For the third sitting, held in this office on Monday, the 15th, we had three such packages. Off the cards of one, 1/32 inch had been trimmed, off those of the second, 2/32, off those of the third, 3/32. The trimming was at the end, leaving the height of the cards unaltered This expedient had been decided upon after the first sitting, during which we had observed that the manner in which the medium held the cards, and the presence of flowers, etc, between them, would make it difficult or impossible for her to detect the discrepancy in length, either by eye or touch, unless she explicitly looked for it

At the third sitting I handed her one of these packages, the one of intermediate length Two cards were missing at the end of the seance, after which I destroyed sixteen on account of stains. Like the first and second sittings, this one was wholly blank in its results, and we were beginning to wonder whether we should have to send Mrs. Y home without having seen her writings. Toward the end of the sitting, while the possible reasons for the repeated failures were being discussed, it was suggested that we go to the open air for our next meeting Mrs. Ned Wayburn, of Bayside, L. I., was present as a guest of the staff, and she offered the use of her lawn. The sitting at which the writings were finally obtained was therefore held in the country on Tuesday, the 16th.

Mrs. Wayburn and I supplied the necessary transportation I took with me all three sets of trimmed cards—31 in one, 49 in each of the others. The two full packages went into use, the short deck remained in my pocket Under circumstances detailed below, we obtained writing on five cards. For various reasons, it was difficult to make certain that all the cards had been gathered up, with this reservation, the count showed that seven cards were missing If none was overlooked, this would mean that twelve were withdrawn and five substituted.

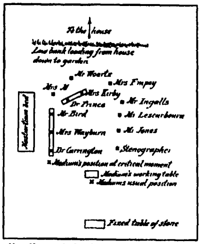
Owing to the presence of the *Times* reporter, and to the necessity that two of the company get back to the city quickly, all examination of the cards was deferred, for, once this was started, we could not tell, in advance, how lengthy or elaborate a process it might be. We therefore made, in the Committee's name, the very obvious and non-committal statement that the medium had made out "a *prima facie* case." Perusal of the story as it appeared in various newspapers would indicate that the editorial profession is in sad need of renewing its acquaintance with the dictionary, so far at least as these words are concerned.

All the cards from the sitting were put in one package, and deposited in my pocket. In my car I took the reporter, Mr Lescarboura and Drs. Carrington and Prince Mr Jones we dropped at Fifth Avenue, Dr Carrington at Columbus Circle, Mr Lescarboura at 125th Street, Dr Prince I drove all the way home to Montclair Dropping him there at 9 o'clock, I reached my own home in Scotch Plains at 9 45, and within three-quarters of an hour I was able to call Mr Lescarboura at Croton and assure him that substitution had been practiced.

The most damning item was that of length The five cards bearing writing were all of the same length as those used at our first sitting, and therefore 1/32 and 3/32 inch longer than those which we put in circulation at Bayside Their number, however, was a coincidence; *they were not our missing cards from the first sitting, substituted back, as the following facts show.*

In color they deviate from our cards to a surprising degree. To a score of persons I have handed a pack of six cards—the five written ones, plus one of ours—so arranged as to expose a little of the blank end of each card. In no case has there been a failure to distinguish our card instantly Our cards are a brilliant white, the medium's decidedly grayish

The micrometer shows further variation In ten thousandths of an inch, the written cards gage, one 120½, two 121 and two 121½ Gaging about a hundred of our cards, the thinnest I find is comfortably over 122, the average is a shade over 123. Gaging in groups of five confirms that the written cards average a full two ten thousandths thinner than ours.



Mrs. M stands for the medium's traveling companion Mrs. Kirby and Mr Woerts are members of Mrs. Wayburn's *family* and Mrs. Empey was her guest. Mr Ingalls is a contributor to our columns and Mr Jones a New York *Times* reporter The other sitters need no introduction

The arrangement of the group at the critical moment in the Bayside seance, when for the first time in four sessions the opportunity for substitution existed

An even more startling way of putting this will be evident if we realize that all of the written cards are thinner than *any* of ours. Approximately 100 cards were at the medium's disposal for this sitting Selecting five of these at random, for spirit writing or any other purpose, what is the chance of hitting upon the thinnest five? Approximately *one in ten billion!*

Nor is this all If actually from our supply, the five written cards were subject to my preliminary selection as well as to the final one by the "spirits," the figure for selection from among 500 then applies, rather than that from among 100 If, as appears the fact, they are really the thinnest five of the entire lot, the chance of their accidental choice is one in 150 trillions!

Ninety of our cards (the full length ones, as used at our first sitting) weigh 9 4 ounces One ounce being equivalent to 28 35 grams, the weight per card may be calculated to be 2 96 grams, on the average The medium's cards, as we are obliged to weigh them, carry the writing, which has a very appreciable weight when measured on a delicate chemical balance But, even with this handicap, our cards are heavier than hers. Weighing five of ours of average thickness, against her five, gives a differential in our favor of 0 179 grams—say 18 grams, for round numbers. This comes to 0 036 grams per card, or 1¼ per cent. If we could weigh the medium's cards without the writing we should certainly double this, at the very least

Finally, the texture of the written-on cards is quite different from that of the cards supplied by us. Our stationer has examined both kinds with his expert eye, and has made affidavit that the cards which I showed him as ours were actually of those supplied by him, while the five that carry the writing were not supplied by him, and are of altogether different stock.

The case, strictly speaking, is complete with this showing, but there are other points of extreme interest In the first place, many readers will doubtless feel that it ought to be explained how the medium *could* practice substitution under our very eyes. Not necessarily how she *did*, but at least how she *could*. On this point a preliminary remark is in order Our conditions are in no case worked out with the view of preventing a medium from operating fraudulently The last thing we want is to be obliged to report that no phenomena were produced If the medium is a fraud, our task is to make him think that it is safe for him to do his stuff, while at the same time providing means for detecting him. It was with this viewpoint that we set up the conditions for Mrs. Y's performance Fake or genuine we had to have conditions under which she could and would work

We should not have searched her at all, save at her own insistence She did insist, on the first sitting in our office, and Mrs. Bird, Mrs. Lescarboura and three stenographers disrobed and examined her to their best ability, in a private office She did not insist at the second or third sitting, but at Bayside she did insist. Mrs. Wayburn and her mother accordingly did the honors Mrs Wayburn reports that, after being searched but before resuming all her garments, the medium stepped into the bathroom, alone, for a short time

A skilled operator would, we believe, have confidence that she would be able to conceal a few small index cards where no amateur searcher could find them. But they would then doubtless be inaccessible to herself She would need a moment alone, before getting herself fully clothed, to transfer them to a more convenient place, which had already been searched. Or she might have planted them in the bathroom before the search and gone there partly dressed to recover and conceal them on her person The circumstances were such as to make this possible, but we prefer the other alternative In any event, we must insist that our "search" of the medium be not taken seriously

On the lawn, the medium complained of the chill, though in our office she had found warmth rather than coolness uncomfortable and inhibitive She asked for an overcoat, and Mr Jones supplied his—a regular horse-blanket of an overcoat, with immense pockets. The medium "warmed her hands" in those pockets, and wore the coat throughout the sitting

For the critical moment when the final step of the substitution was achieved, I must fall back on Dr Prince's observations. At all sittings he had been watching for the occurrence of a blind angle, behind or beside the medium, so placed that in their positions of the moment none of the sitters could see into it In our office, when not actually surrounded by the audience the medium had faced such a wide semi-circle that no blind spot could exist. Moreover, her back was to an open court, across which our clerks were looking on. Mrs. Y was uneasy and suspicious about this, even after we drew the curtains on the offending windows

At Bayside, after several rearrangements, the condition diagrammed was ultimately brought about, with the audience in a long narrow horseshoe, Dr Carrington on one horn and his immediate neighbors robbed of some freedom of motion by the fact that they sat together on benches rather than alone on chairs From here I quote Dr Prince's report to me

"Mrs. Y's practice is to place the pack upon the head of some person present and she has made great show of holding out her left arm at the supposedly decisive moment, to show that it has nothing to do with the phenomena But finally at Bayside, when Dr Carrington was seated at the extreme right of the semi-circle, she placed the cards upon his head taking a position which shielded her left side from the entire company At this moment I saw that her left arm was at her side, contrary to her usual practice. She then brought the pack of cards in her right hand down to her left, while the latter was still shielded; then immediately both hands were

(Continued on page 441)

ON October 16 there were produced for the SCIENTIFIC AMERICAN *Investigating Committee, by the medium Mrs Y, five cards with "spirit messages," alleged to be precipitated upon them in coloring matter extracted by the psychic operators from flowers and a gold bracelet On critical examination, the Committee finds that these cards are not of the lot supplied by them for this seance, but were brought in and substituted for such cards This decision is based on the following considerations*

I. The cards supplied for this sitting were 4 29/32 and 4 31/32 inches long Those on which the writing was produced were five inches long, the same size as the cards supplied for a previous sitting, some of which were missing after that sitting

II The cards on which the writing appears are of a distinctly grayer color than those supplied by the Committee

III The cards on which the writing appears are, on the average, two ten-thousandths of an inch thinner than those supplied by the Committee

IV Every card written upon is thinner than any of the cards supplied by the Committee The chance that this would occur, in accident and by good faith, is one in 150 trillions.

V The cards on which the writing appears weigh, on the average, 0 036 grams less than those supplied by the Committee, in spite of the fact that they must be weighed with the writing The difference would be at least doubled if this could be avoided

VI The texture of the written cards, as examined by an expert, is more mottled and less even than that of the cards supplied by the Committee

Our Abrams Investigation—III

Comments on Our First Test and a Look Ahead to Other Tests and Studies

By Austin C. Lescarboura

Managing Editor, Scientific American, Secretary to the Scientific American Abrams Investigation Committee

AS WAS to be expected, we have heard from all parts of the country regarding the report of our first test of the electronic reactions diagnosis, which appeared in our November issue. The comments represent three distinct shades of opinion. First, there are the orthodox medical men who, quite naturally, are pleased with the negative results; secondly, there are the electronic practitioners who are obviously disappointed with our findings, but who are just as ready to offer reasons for the negative results; thirdly, there are the laymen who, in the capacity of final arbiters in this matter, are glad that our investigation is under way.

It would be quite impossible to quote the various comments which have been received, but it is our intention here to present in digested form the various shades of opinion and comment which have been presented.

When we first entered this Abrams electronic controversy, it was our original and superficial opinion that the subject matter could be readily dealt with. The claims, fantastic as they *might* seem in the light of orthodox medicine, could readily be checked up so that a favorable or unfavorable decision would be arrived at in short order. It also appeared to us that we were dealing with but one definite method of diagnosis and treatment, namely, the electronic reactions of Abrams—known as E. R. A., for short. This, of course, would make the matter relatively simple. Instead, and much to our surprise, we have already learned that there are many variations of the electronic reactions diagnosis and treatment. Abrams stands as the originator of this entire technique, but there are many departures from his teachings. Here and there we find entirely different methods of harnessing the electronic reactions, so that it becomes necessary to differentiate between the true Abrams electronic reactions and those of other brands.

And so we hasten to reiterate at this time that the equipment and the methods employed by Dr. X, who cooperated with us in our first test of the electronic reactions diagnosis, are not those employed and recommended by Dr. Abrams. The air-column method of percussing, which we described at length in the report, is no longer employed by the Abrams practitioners who have better methods, so they claim, of detecting the electronic reactions of the human reagent. The equipment used for our first test was not manufactured by laboratories and individuals authorized by Dr. Abrams, although, truth to tell, the equipment in question struck our critical eye as being of better workmanship, so far as externals are concerned, than Abrams apparatus which we have seen elsewhere.

Now, then, we are confronted by a curious situation. We must make certain in every test that we are dealing with genuine Abrams equipment and technique, or with some other equipment and technique. Dr. Abrams himself has warned us not to confound his methods with those of others, and to bear in mind that there are over forty "bogus" electronic reactions devices on the market.

To differentiate between the genuine Abrams article and others is not a difficult matter. But our obstacle takes the form of giving the electronic reactions diagnosis an unbiased and thorough test. If we are to listen to Dr. Abrams and his immediate followers, we are told in no uncertain terms that Dr. Abrams himself, and no one else, should receive all our attentions. We are even cautioned against making experiments with the leading exponents of E. R. A., although we are entirely at liberty to get their views and comments regarding the subject matter. And to simplify our investigation, our committee is invited to visit Dr. Abrams at his clinic and laboratories in San Francisco.

A visit to Dr. Abrams and a rigid test of his technique should form an important part of our investigation, it goes without saying. However, our tests must also deal with recognized Abrams practitioners, if for no other reason than the obvious one that the average individual never deals with the originator of this technique but with one of his local representatives. That is the important point. We mean to test the E. R. A. under real, practical, everyday conditions, so as to have a workable decision with regard to the entire question, rather than a theoretical, unfinished, imperfect, and, to speak plainly, "staged" investigation which would leave the laity quite dissatisfied and completely at sea.

We have received from Dr. Abrams a list of recognized E. R. A. practitioners within ready reach of our investigating committee, and we shall make every effort to secure their cooperation in our work. Already, several of them have shown the keenest interest in our work and a willingness to aid in every way. At this writing we are arranging for a test in which a number of recognized Abrams practitioners will take part. A collection of pure germ cultures, prepared according to their instructions but quite without their knowledge, will be diagnosed by these practitioners and their various findings checked up with our list of the cultures. This demonstration will be most interesting. We hope to have the report for our January issue.

So much for the authorized E. R. A. practitioners. But now we come to the real complication. It seems that the electronic reactions technique is far from a perfected thing and that much remains to be learned. Indeed, almost weekly some new "rate" is discovered and some short-cut or better way of diagnosing and treating is developed by an E. R. A. worker. Contrary to the prevailing opinion, Dr. Abrams is by no means responsible for all this technique, for much of it has been contributed by his followers. Most of the E. R. A. workers adhere closely to the Abrams teachings, but here and there an E. R. A. worker strikes out along new lines. In fact, some E. R. A. practitioners are frank to say that they have used Abrams' original teachings to become acquainted with the electronic reactions, and then have developed their own equipment and technique which, if we are to believe them, are far in advance of those of the originator.

Now the point is that these distinct variations from the Abrams technique cannot be ignored for a moment. While our investigation is termed an "Abrams" investigation, it now develops into an investigation of the electronic reactions proper, taking in all manner of equipment and technique which still bear some semblance to the E. R. A.

Some E. R. A. practitioners whom we have met have impressed us with the fact that they, rather than Dr. Abrams, can give us a convincing demonstration of the merits of the electronic reactions. They have told us that Dr. Abrams has discovered a wonderful thing, but that he has not developed it to the full. Meanwhile, after they became acquainted with the fundamental truths and the original technique of Abrams, they have forged ahead with their own equipment and technique and have left Abrams some distance behind in electronic reactions practice. Some have boldly set up their own technique and have broken off entirely with Dr. Abrams, while others still retain the right to use the E. R. A. designation, but are frank to state that their methods deviate sufficiently from those of Abrams to make their work that much better.

Efforts have been made over and over again to impress us with the fact that these electronic reactions workers are far better exponents of the fundamental discoveries and possibilities of Dr. Abrams than Abrams himself. Indeed, we have been asked to devote the better part of our tests to these improved methods which, we are assured, will give us positive results where Abrams himself would perhaps fail.

Much the same may be said for the equipment employed. We have received numerous pieces of literature put out by manufacturers of electronic equipment, the writers of which have displayed real art in inspiring the reader's confidence in the electronic reactions on the one hand, and then, by subtle argument, swinging over the reader to some particular kind of apparatus which gets results when the others fail completely. We were somewhat thrilled when we received what appeared to be a real, scientific, and thoroughly comprehensive report on electronic diagnosis and treatment of disease, written by a consulting electrical engineer. The title page and the diagrams led us to believe that here, at last, was a serious report on the subject which would throw considerable light on the intricacies of the electronic technique, by giving us the salient facts in simon-pure English. Much to our disappointment, however, the report goes on to tell us that there is something in the teachings of Abrams, but that the existing apparatus is crude and unreliable, and that there is better apparatus now available which will give positive results. Subsequently, by another mail, we receive a bulletin announcing NEW apparatus for electronic diagnosis and treatment, in which all the former drawbacks and imperfections have been obviated and many novel improvements have been made. Needless to say, this bulletin comes from the same source as the report already mentioned.

Hence we shall have to devote our attention not only to Dr. Abrams and his E. R. A. workers, but to other electronic workers who claim to have something better than the original technique. Furthermore, we shall have to disregard the personal equation in our investigation. Merely to scratch the surface of the Abrams question soon discloses that there is little love lost between the various electronic practitioners, and that their references to one another are most uncomplimentary but at all times in perfect reciprocity.

Returning to the comments on our first test, the E. R. A. and other electronic practitioners seem agreed that Dr. X did not know what he was doing. "Why report findings of from 49 ohms to 158 ohms of streptococcic infection, when less than two ohms is as high as these infections can ever go?" asks an E. R. A. worker in criticising our test and our findings. Others have brought the same point to our attention. Our reply is that we did not determine these readings. They were given to us by Dr. X himself, *working at his rheostats*. It *does seem*, however, that due allowance must be made for the fact that Dr. X was working on pure germ cultures, instead of a tiny speck of blood; that should make some difference in the ohmages.

We have been seriously reprimanded for giving any attention whatsoever to Dr. X, since he is not a recognized E. R. A. worker. What we have already stated in the foregoing account of the electronic situation as we found it to exist, explains why we must make tests wherever we believe we can learn something regarding electronic technique. Dr. X, who has been giving electronic treatments to a large clientele in New York City and has recently developed new equipment for which he makes revolutionary claims, was the first to come forward and extend his cooperation to our investigating committee.

We have been criticised for not mentioning Dr. X's name, but we believe that it is best, for many reasons, not to mention names in an investigation of this kind. If our findings in any one test are adverse, it is best not to mention names. If our findings are favorable, again it is best not to mention names. We are not investigating one doctor or another; we are investigating electronic medicine as a whole. The doctors and E. R. A. workers and other electronic workers are invited to cooperate with us so that we may present the true story of electronic medicine to our readers.

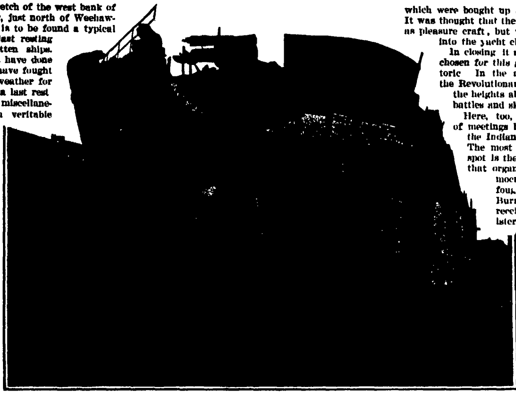
(Continued on page 446)

AN investigation of the electronic reactions of Abrams and other electronic methods of diagnosis and treatment has been undertaken by the SCIENTIFIC AMERICAN. A committee of competent, unbiased, keenly interested scientists will formulate the various tests to be undertaken as well as pass upon the results obtained. The investigation is based primarily on obtaining first-hand data as the result of our own tests and observation. We are investigating the electronic technique as a whole, and not the individual practitioner. We invite the cooperation of everyone, in order that the true facts may be presented to the public.

The Last Harbor of Forgotten Ships

Where Old-Time Clipper and Modern Submarine Chaser Meet for the Attention of the Salvager

ALONG a goodly stretch of the west bank of the Hudson River, just north of Weehawken, New Jersey, is to be found a typical graveyard—the last resting place of forgotten ships. Here, vessels that have done good service in their day and have fought their way through wind and weather for many a long year, have found a last resting place. It is a weird and miscellaneous gathering of derelicts, a veritable museum of types of all periods and of every manner of construction. If there is any future life for these vessels, it lies in the salvage which is taken out of them, for their iron is recast or reworked, to do service in many of the different arts, their timbers also are used for structural purposes, sometimes even to shelter man once more from the milder mischances of wind and weather upon the shore, while the richest of all treasure trove is the copper and brass which find their way into arts too numerous to mention.

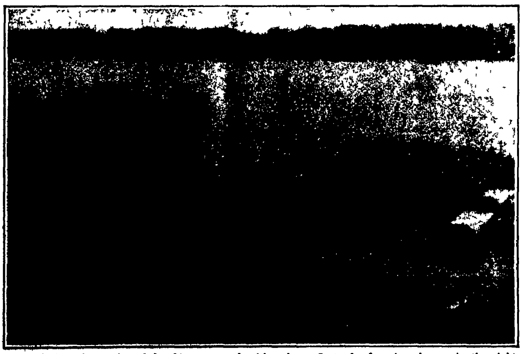


Remains of the historic old "Granite State," ready for the salvager. The timbers in old ships such as this one find a variety of uses

Perhaps the most appealing among these works are the fine sailing vessels which stand there, gaunt and stiff, like fine old aristocrats of a former day, with their graceful prows lifting high above the water. With the coming of the war, these old sailing ships found a use, and from out of harbors here and there along the coast, came to do service as freight carriers. Their period of service, however, was short, and at the close of the war many that were not sold abroad found their way to the graveyard.

Many types are included among these old sailing ships. Among them are representatives of those beautiful vessels, the clippers of the fifties and sixties, probably the most perfect merchant craft that were ever propelled by sails. In their day, the best of them surpassed the steamships in speed. That was in the period when the United States stood in the forefront of the ocean-carrying trade. For many months, one of the most interesting of the derelicts was the "Granite State," which was brought over here from across the river, after being burned at her dock, to be broken up for the copper, brass, etc., that was in her. Subsequently, while being towed north for final breaking up, the "Granite State" caught fire again and went to the bottom. This representative of the old three-deckers dated from the time of sail power and the smooth-bore. Not far from her stands what was once the flagship of the New York Yacht Club, the "Electra." In her dismantled condition, she is hardly recognizable, and seems to be a symbol of the familiar tragedy which made her owners wish never to see her again. Then we notice the old floating dry docks, dating from Heaven only knows how many decades ago. And of course the lighter, that indispensable element of harbor traffic, forms a conspicuous part of the assembled ships. Here also are to be found canal barges, some of which must, from the look of them, date back almost to the opening of the Erie Canal. Farther along the shore we see the "Hatteras," its name recalling the gaieties of fifty years ago when she was the queen of river boats and her decks, as she went up and down the quiet waters of the Hudson, resounded with music and the shuffling steps of the dances popular in those days. Close by is another famous boat, the old excursion barge, the "Columbia," memorable in the minds of the sporting fraternity from the fact that here John L. Sullivan fought one of his famous battles.

Of course, the most striking group of vessels is the closely packed fleet of submarine chasers, sixty of which were bought up after the war as a speculation. It was thought that there would be a demand for them as pleasure craft, but very few have found their way into the yacht clubs.



General view of a section of the ship graveyard, with a large fleet of submarine chasers in the right foreground. The background is formed by the up-town section of Manhattan Island

In closing it may be mentioned that the spot chosen for this graveyard of ships is itself historic. In the adjacent country campaigns of the Revolutionary War were conducted, and on the heights above, placards tell the stories of battles and skirmishes.

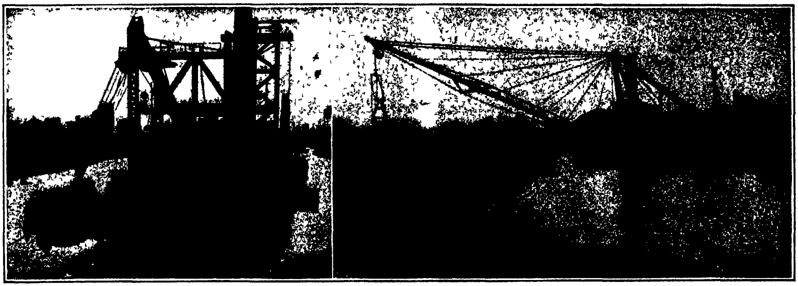
Here, too, there are thrilling memories of meetings between the white settlers and the Indians, and of deplorable massacres. The most melancholy association of this spot is the death of Alexander Hamilton, that organizing genius of our young democracy. On the cliffs above he fought a so-called duel with Aaron Burr and with his pistol in the air received the fatal bullet of that sinister character of our early history.

Copenhagen-Bornholm Wireless Telephone Service

THE island of Bornholm, which so far enjoyed no telephone or telegraph communication with the rest of Denmark, has just been connected with Copenhagen by a combination of radio and wired telephone systems, subscribers at both ends communicating with one another without any special apparatus merely by calling up the exchange in the usual manner. While the transmission of weak telephone currents to the radio transmitting station and in a similar manner, the transfer of feeble receiving impulses to the telephone line at the receiving end entailed a suitable amplification by means of vacuum valves, special difficulties had to be overcome in insuring a duplex service, i.e., the possibility of simultaneous transmitting and receiving without any mutual interference and without any necessity for the subscriber to switch over from one service to the other. The proper distribution of the speaking and listening currents is effected by means of a "distributor" working on the Wheatstone bridge principle.

A new Lorenz-Poulsen transmitting station has been provided near Lyngby at the Copenhagen end an isolated loop aerial on a 25-meter mast being used to receive the electric waves. The receiving plant is installed in the island of Amager to the southeast of the Danish capital. At the Bornholm end, another Lorenz-Poulsen transmitter has been installed at Hammeren, in the northern angle of the island the receiver being situated near Rönne Harbor, on the western coast.

Successful radio telephone tests between the Copenhagen and Bornholm apparatus, on the one hand, and Berlin, on the other, were made previous to the opening of the new service, thus demonstrating its possibilities under conditions more exacting than the daily routine. Other tests were made between Copenhagen and the American steamer "United States," whose captain, while on the high sea remained in permanent telephone communication with Copenhagen telephone subscribers, very much like our tests with the S. S. "America."



Left: The suction dredge "Cyclone," the property of the Toronto Harbor authorities but loaned to the contractors for the Queenston-Chippawa power project. *Right* The dredge "Mars" closing a levee break north of Sacramento (1915)

Two famous dredges engaged in important work

Some Great Dredges

Monster Grab-Buckets that are Able to take Fifty Tons of Mud and Rock at a Single Bite

By J. F. Springer

EXCAVATING apparatus has been greatly developed because of the demands made by general construction in the United States and Europe particularly such great works as the Suez Canal, the Chicago Drainage Canal and the Panama Canal The steam shovel is largely responsible for the success at Panama in cutting through the dividing ridge separating the oceans. The dredge cut the canal in the fresh and salt water sections and built a great part of the monster Gatun Dam If a slide, big or little occurs, it is the dredge which is relied on to open up the great waterway again

All over the country, dredges are more or less in use. They float from point to point, and excavate soft and hard material On the Panama Canal, though the big ditch has been completed for a number of years, serious excavation is still going on From the canal prism itself, some 3,711,819 cubic yards of earth and rock material were removed in the fiscal year ending June 30, 1920. All of this, in addition to auxiliary work, was done by six big dredges, three of them being of the dipper type and three of the pipe-line suction class. The dipper dredges—the "Paraiso," "Gamboa" and "Cascadas"—are giants. The great dipper on each has a rated capacity of 15 cubic yards. It is big enough, when set with the opening up, to permit 34 men to stand, without undue crowding, upon a platform suspended inside the great opening The "Paraiso" was one day engaged in its work, the great hull, from which the gigantic arm and dipper are operated, floating quietly on the smooth water The operator had no notice of anything unusual until he saw a stone appearing above the surface. It was a monster 50-ton stone that was being brought up by the dipper No shock or tremor seems to have been felt on the vessel when the dipper secured its great load. The stone must have weighed, even when totally submerged, around 30 tons. Upon emergence the weight naturally went up to the 50 tons. A mighty machine, indeed that can take in so quietly at the end of a long lever such a weight as 30 tons and that is not disturbed when this weight grows to 50 tons. It was thought rather unsafe to put the stone in one piece on the attendant scow In fact it was blasted three times while still on the dipper, and thus reduced to manageable sizes. In nine months in the fiscal year just mentioned, this same "Paraiso" excavated 947,360 cubic yards of material, over half of which was rock The unit cost is estimated at having been $0.44109 per cubic yard The sister dredges also did great work, though at costs somewhat higher

The pipe-line dredges are also big fellows and competent to the performance of severe service.

Some may wonder that so much work is going on at Panama Part of the work consists of new construction and part is to be classed under "maintenance" As a matter of fact, the new construction amounts to only a small percentage of the whole. Upon July 1, 1920, there yet remained to be taken out of the prism of the canal the very considerable amount of 3,280,000 cubic yards of earth and rock. This material may be classed as siltage, material from slides, and original material. Really, the canal will never be done, even when there are no more slides and when all original material has been taken out and away Gatun Lake, through which a very large part of the canal runs, is the recipient of waters belonging to the old Chagres River The torrential streams thus made tributary to the lake bring down naturally their quotas of material from their several watersheds. However, it will probably be some time before the last slide becomes a matter of history As long as there is any real reason to fear a considerable slide, the dredging capacity will have to be kept at a pretty high level

Dipper dredges operate much after the manner of the regulation steam shovel. There is a great boom which furnishes a fulcrum for the operation of the arm at one of whose ends the bucket is attached. A rope, secured to the bucket and passed over a wheel at the end of the boom and thence carried back to a drum on board the vessel, provides the means of swinging the dipper-arm. The dipper is continually open on the side next the material to be secured On the opposite side is a bottom hinged on the side next the arm. Ordinarily, the load, when secured, lies inside the bucket. It is dumped by releasing the hinged bottom, where the material drops onto the pile or scow The action is entirely different from that of the pipe-line suction dredge In this case, the material is sucked in through an opening and then pumped on through a pipe line. By the use of relay pumps, the material, together with a quantity of water, may be conveyed long distances and to elevated positions. In the original construction of the Panama Canal, part at least of the material for Gatun Dam naturally had to be elevated. In certain comparatively recent work on the canal, the dredges were just about a mile distant from the outfall

There are quite a number of varieties of dredges. On the Pacific Coast, for example, recent years have seen the introduction and use of big clam-shell dredges. The clam-shell excavating bucket has been found very useful in dry excavation, and in the handling of coal. It and the orange-peel bucket have also been found serviceable in wet excavation. The clam-shell bucket consists of two halves which open from and close upon each other much as do the valves of a clam. A good type of bucket will bite into the material being excavated and thus secure a good load. That is, they dig as well as shovel

On the Sacramento River, certain big dredges, as the "Neptune" and "Mars," have been doing great service. Naturally, the vessel must be a considerable affair It is provided with an A frame or an equivalent as a means of providing locations from which a great boom may be operated. This boom may have the enormous length of 240 feet, and the bucket operated from its outer end may have a capacity of 8 cubic yards. This is but little more than half the capacity of the three monster dipper buckets on the Panama Canal giants. On the other hand, a boom of 240 feet has a reach far beyond anything possible with the dipper dredges. In fact, the latter must discharge close-by, as on to an attendant scow; while a long boom operating a clam-shell bucket may operate in a pretty wide waterway and still deliver material

Dipper dredge of eight cubic yards capacity at work in the Chicago Drainage Canal

secured ("spoil") to either bank. It is said that canals having a width on the bottom of 500 feet have been constructed by this type of dredge without requiring any rehandling of the spoil.

Ordinarily, the boom is set with its outer end at the desired level and is then not lifted nor lowered while the bucket gets and discharges its load. The boom is, however, swung in a horizontal plane, thus enabling the bucket to carry the material to the shore and to return to the excavating point.

15-yard dipper dredge "Gamboa" at work on Cucuracha Slide, Panama Canal

An interesting feature of these great dredges is the enormous boom having a length of 240 feet. Timber is used in the construction, and is in fact believed to be the only suitable material for the severe service calling for great elasticity. This size of boom is made up by using sections 110 feet long. The joint is made by scarfing the ends and then bolting them together. The length of such a joint is 27 feet. In order to control lateral bending, the booms are strengthened by means of a cable which passes through saddles arranged on the ends of cross-arm struts. There is a certain amount of slippage permitted and this gives a degree of flexibility. Numerous guys run from the A-frame to points along the length of the boom and at ends of the struts and thus add to the power of resistance to loads at the end of the boom. In fact, prior to the attachment of the bucket, the guys are so adjusted as to lift the far end a distance of 2 feet. This is to compensate more or less completely for the bending consequent upon the weight of the bucket and its load.

An interesting feature concerns the method of compensating for the dip of the boom consequent on the list of the vessel when the boom with its load is swung. It has been found that the overhang of the A frame has a tendency to elevate the boom when it is swung. As this is a tendency the opposite of that produced by the list it may be utilized for the desired purpose. It is, however, necessary to adjust the overhang to just the right amount to produce the best results. It is understood that it is possible so to put the one thing against the other with each particular dredge as to make it practicable to swing the loaded boom end in a substantially horizontal plane. The operation of the booms is controlled by the use of two cables running through sheaves at the ends of the booms. When the earlier designs were in use, the high winds which often prevail over the lower section of the river made it difficult or next to impossible to operate the dredges during their continuance. But now, a recent improvement has been adopted, which consists of providing water ballast tanks along both sides of the vessel. These tanks can be operated in such manner in conjunction with the overhang as to offset an athwartships wind and thus permit the boom to be worked somewhat as usual.

Another advance in design is one that concerns the operation of the two control cables. A great variation in the positions of the cables is required in order to control the boom in widely different locations. A pair of sheaves was, in the earlier dredges, attached to each of the two sides of the A-frame down near the base. These sheaves, known as "sister sheaves," were to provide sheave action whenever possible. It was found, however, that one or more times during every cycle of operations, the cable would cut across the flange of a sheave and suffer abrasion in consequence. The improvement in design consists in the use of a single counterbalanced sheave which is so designed that it automatically adjusts itself to any and all positions without inducing more than one bend in the cable. This change has resulted, it is understood, in a considerable prolongation of the life of the cables.

An idea of the size of these dredges may be got by a consideration of some principal figures. The "Neptune," for example, is about 150 feet long and 70 wide. The depth is 13 feet. The top of the A-frame rises about 82 feet above the deck. At the apex of the A is attached the topping cable—that is, the cable which lifts the boom. It is rigged in 10 parts and consists of a galvanized steel rope 1⅝ inches in diameter. It is estimated that the stress on this cable when the bucket is loaded is about 110 tons. The bucket itself weighs 15 tons and the load about 12 tons. The boom is a heavy affair weighing around 12 tons. The cable acts at a disadvantage because its angle of elevation above the horizontal is necessarily a flat one, and this is the reason why a weight of 27 tons plus some additions from the boom is able to produce a stress of 110 tons. Certain "hog rods," 3½ inches in diameter, have the duty of holding the A frame. It is said that these rods endure, at the time when a full load is swung the maximum distance on one side, a stress of 145 to 160 tons. The legs of the A-frame are likewise put under severe compressive stresses at the same time.

That there must be nothing faulty in the rigidity of the construction will perhaps be glimpsed when it is learned that such dredges as the "Neptune" and the "Mars" are operated 24 hours per day and that a cycle of operations is gone through with in from 108 to 120 seconds. The big dipper dredges at Panama are able to go through a cycle in much less time, when a great struggle was going on to beat the slides, they were put upon a cycle-time of 45 seconds.

The Lifting Lock

THERE is more than one interesting variant upon the ordinary canal-lock. Along the line of the Old Morris and Essex Canal, for instance, which climbs the Jersey hills at numerous points, may still be seen the remains of the "canal railways" by means of which these climbs were effected. These are nothing more or less than inclined planes, separating the two levels of the waterway, up which the boats were hauled bodily on a wheeled carriage at the end of a cable. Another, and more finished, expedient, is the one which we illustrate herewith. The photograph is taken at Peterborough, Canada, but similar installations are found here and there throughout the world, and we have a dim recollection of having described one of them before.

In the case of Peterborough, the stream is a part of the Trent water-power development, and, at the same time it is desired to have the way navigable for barges of moderate size. There is a material descent at Peterborough, one of the points of actual power development. Instead of the ordinary lock, the hydraulic lift is employed. This consists, in effect, of a big elevator, sufficiently large to accommodate any vessel which the stream itself would accommodate. If the lockage is to be in the downward direction, the lift is raised to the upper level, in which position it is adjacent to the regular waterway on this level, and like an ordinary lock, constitutes in effect a continuation of this. The gate between the river and the lift is opened, and water flows in to fill the lift after which the vessel is admitted and the gate closed. The lift is then lowered to the lower level, where the gate at the other end is opened and the vessel goes its way.

When the lift is being raised, empty, the right hand gate of our picture is allowed to remain open so that the load of water does not have to be raised too. When it is being lowered empty the water is allowed to remain in it to aid the lowering with its weight. The system is particularly adapted for use on a power waterway, since it uses less water than the ordinary lock which has to be filled to its entire depth corresponding to the difference in elevation between the two levels, and the water used for this purpose, in a downward lockage, comes from the power flume.

The Peterborough installation is believed to be the highest of the kind in the world. The lift which we illustrate seems to scale about 60 feet in height when measured against the men standing on the upper level. It raises or lowers a vessel in twelve minutes.

The Peterborough (Canada) lift-lock, combining the features of a lock and an elevator

Driving the Bomber to High Altitudes

Latest Guns Make the Air Deadly at 20,000 Feet, and Dangerous at 30,000 Feet

AS MATTERS stand today no matter how excellent may be the new guns and other military material developed by the Army and Navy the question of whether the nation shall make and use them is decided by the inexperienced layman. Before these improved weapons can be built in numbers the money for their construction must be appropriated and the appropriations are determined by a Congress that is not and does not profess to be scientifically trained. Although this is a wise constitutional provision it has the serious defect that due to lack of knowledge or to misinformation Congress is liable to withhold funds when they are urgently needed or to grant them for experimental devices which subsequently prove to be useless.

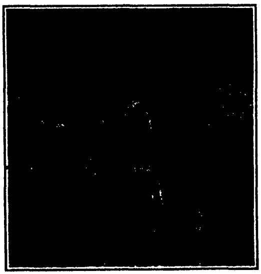
These conditions are always perilous and they are particularly so today in regard to the military value of airplane bombing. The public is always attracted by the spectacular and unfortunately the experimental bombing of battleships as carried out two years ago and this year off the Virginia coast when several anchored battleships and cruisers were sunk has made such an impression on the minds of those who undertake to write about Navy and military matters that they have proclaimed the battleship as already doomed and the airplane as supreme. Why build a battleship costing $40 000 000 when an airplane costing the merest fraction of that sum can sink it with a single bomb?

There are two major fallacies in talk of this kind. First the ignoring of the fact that the battleships attacked were anchored; the second that they were provided with no means of defense whatsoever. The death of these battleships was as certain as is the death of an ox when it is struck by the poleaxe of the butcher.

Much has been made of the fact that a vast amount of anti aircraft ammunition was expended in the world war to very little effect but the anti aircraft guns of 1914 to 1918 were feeble weapons compared with the anti aircraft artillery which has been developed since the armistice. Enemy airplanes during the war were accustomed to fly over hostile territory at low elevation *with comparative immunity for the reason that the* range of the anti aircraft artillery and its rapidity and accuracy of fire were limited. Today the low wartime zones of flight would be literally sprayed with machine gun bullets and with a barrage of bursting shrapnel. Moreover what is true of the land fighting of the future is true also of fighting upon the seas. The battleship will bristle with machine guns with a maximum vertical range of 12 000 feet and with automatic guns firing 1½ inch high explosive shells with a maximum range of 14 000 feet. Three inch guns have been developed by the army which are effective at 21 000 feet and 4 7 inch guns with a vertical range of 30 000 feet. Furthermore it must be remembered that the shells from these weapons thanks to tracer ammunition leave a visible trail of smoke behind them and are capable of being brought to bear directly upon enemy airplanes up to ranges of 7500 feet 14 000 feet and 21 000 feet. Now if in the bombing experiments off the Virginia coast effective hits could be made only *at elevations of from 3000 to* 6000 feet and then only because there was no interference to [illegible] the helpless battleships below what kind of shooting would have been done had the air been sown with machine gun bullets and high explosive shells and shrapnel, effective at elevations of from 7500 feet to 21 000 feet? We doubt if a hit would have been made.

Our 3 inch anti aircraft gun, Model 1920, in the firing position

Gentle reader whenever a so-called naval or expert military writer tells you that the battleship is doomed and that aircraft are masters of the sea and shore and sky alike be so good as to remember the facts given above and cease either to be misled or worried by these wild and altogether *unjustified statements* that the battleship is doomed and that all future attack and defense will take place in the air.



New 50 caliber water-cooled machine gun. Vertical range 9000 to 12,000 feet. Fires 500 shots a minute

In referring to the great altitudes to which anti aircraft guns have attained we have in mind particularly the new weapons which have been developed by our Coast Artillery assisted by the Ordnance Department. The description of these guns, as given below reveals it will be seen *a truly marvelous advance over* the anti aircraft artillery of the war and it is certain that the difficulty of making direct hits with bombs on a specified object, such as a ship or a fort, has been greatly increased by the high altitudes at which the bombing craft will have to operate.

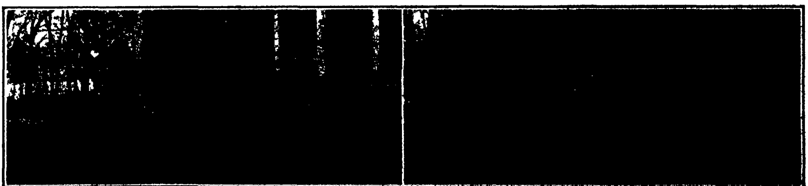
There are four new types of anti-aircraft guns now in process of development. The first of the new guns is the 50-caliber machine gun with a horizontal range of about 27,000 feet, a straight-up range of 9000 to 12 000 feet and a rate of fire of about 500 shots a minute. (So far as we know, no data are as yet available from which can be determined the degree of accuracy which might be expected of bomb dropping from anything like an altitude of 9000 feet.) Fire control is to be maintained with this gun through new tracer ammunition visible night or day up to 7500 feet. (Surely this method of fire control—really nothing more than playing a hose—can be exercised from the deck of a battleship.) The 50-caliber gun is under manufacture for issue as a substitute for the 30-caliber weapon now used.

The second gun under development is a 37 mm machine gun firing high explosive shells with fuses so delicately adjusted that the shells, while safe to handle before firing *explode on contact with balloon fabric* once they have been discharged from the gun. A *rate of fire of 100 to 120 shots a minute is expected* with this weapon with a straight up range of 14,000 feet and tracer ammunition visible up to 10 000 feet making possible accurate firing up to that point. It may be said that at this time this is a future prospect. This is true but the handwriting on the wall says that it is time for the Air Service to begin demonstrating what they can do in the way of bomb dropping at these and still greater altitudes. It is planned to install these weapons in batteries of four operating with a single telescopic sight control and to be trained and fired by a single gunner. (Another case of "playing the hose"—only this time the hose has four nozzles. Would it be much more difficult to train the ordinary "Jack Tar" to play this hose accurately on an airplane the pilot of which had the hardihood to come within its zone of operations than to train him to play the usual type of hose on the battleship's deck?)

The third new gun in the group is a 3 inch weapon *on a mobile mount* with a *rate of fire of fifteen shots a* minute effective at altitudes up to 21 000 feet and with full 360-degree traverse to enable the gunner to follow his target in any direction. It can be fired at an elevation of 80 degrees and has a horizontal range of more than 38 000 feet with projectiles weighing 15 pounds and containing a heavy bursting charge. Guns and mounts of this type are now under test at army proving grounds.

Gun No 4 in the anti aircraft list is the 4 7 inch, firing a 45-pound shell to an effective altitude of 30,000 feet. Its horizontal range is in proportion. It is to be mounted on a mobile carriage with full traverse and equipped for power loading and with an automatic breech block to speed up firing. This gun also can be fired at an elevation of 80 degrees, or within 10 degrees of straight over the gunner's head.

The experts are working out a system of indirect aiming experiments having shown that central control *firing is greatly superior to the old systems.* Two types of central stations are under development, either of which will materially speed up aiming and firing.

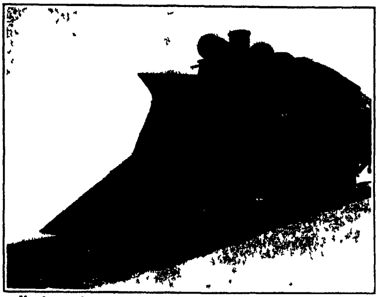


Left: Our 30-caliber anti-aircraft machine gun ready for action. Note the pneumatic-tired wheels which make this gun exceedingly mobile. The second cart carries the ammunition. *Right:* The 60-inch anti-aircraft searchlight mounted on a light truck

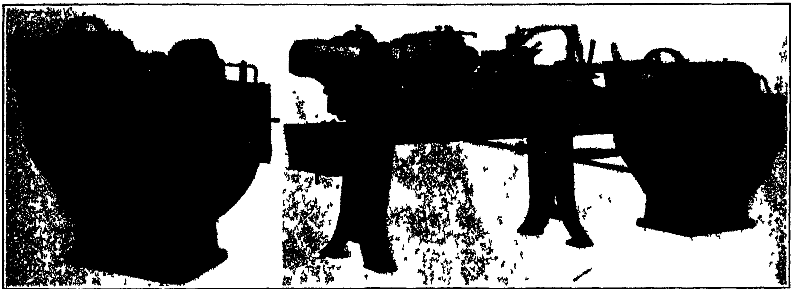
All Fixed for a Hard Winter

THAT present winters are as a class, any different from those of olden days is a fallacy that has been pretty well exploded. Not alone because twice during the past six years we have had extreme instances of what a temperate climate can produce in the way of winter tie-ups but because the long term constancy of our weather is getting to be more understood on general grounds the period since the war has seen the development of machinery for combating on a scale hardly before attempted the snow storm blockade of railroad, of street and even of the ordinary paved road.

With the advent of the winter of 1921-1922, the management of the Philadelphia and Reading Railroad decided that it would not be caught napping. If any of its trains were to be held up by snow it was desired to insure in advance that this would be because they had encountered a drift of truly extreme size, and in no sense because they were poorly equipped to do battle with the forces of winter. The rather amazing contraption pictured on the front of the locomotive herewith is the design which has been ultimately worked out with this end in view. Doubt that it would do as well as the powerful rotary in boring its way through extreme snow drifts is met by the statement that it is more immediately intended for the ordinary snow fall of a few inches or maybe a foot or two which is to be expected continually throughout a fairly severe winter—that it aims to prevent this from developing into something that only rotaries good luck and sunshine combined can combat with prospects of success.



Novel snow plow, expected to be of unusual value in dealing with falls of moderate depth



Left Front view with sheet metal doors removed to show accessibility of the cams. *Right* The iron man attached to the turret end of a screw machine

Two views of the attachment for automatic operation of hand screw machines

For the Hand Screw Machine

ADDITIONS and improvements to hand screw machines have been in the direction of improving the machine itself or of changing it into an absolute automatic. Now an Indianapolis manufacturer is putting on the market an attachment which does nothing to the machine except to operate it automatically.

The new attachment fairly merits the name of "the iron man" which the maker has bestowed on it. It consists really of a disk, mounted upon a frame which is completely enclosed for protection upon which are flat cams that operate cross-heads by means of contact with rollers that operate the various levers through reach rods. This makes it possible for one man to operate as many as six machines. The machine can be started, reversed and stopped the back gear thrown in and out, the turret indexed, and the cut-off and forming tools operated as often as desired.

The attachment of the iron man to a screw machine does not call for any alterations and in no way affects the availability of the machine for use without the automatic attachment.

Bumping the Bumper

CONSIDER the bumper. It toils not nor helps the motor to spin yet every car owner knows that it is often a valuable thing to have upon his machine. It is usually more bumping than bumped against while in service but the opposite is true before a tested and approved bumper reaches your chassis.

When the companies issuing automobile collision insurance proposed to credit a reduction in the premium where bumpers approved by the Underwriters Laboratories are used the task of testing such attachments appeared to be an easy matter. In actual practice however a number of difficulties developed.

It was found for instance that it required no less than 400 different shapes materials and methods to mount a single style of bumper upon the various makes and models of passenger cars. The necessary fixtures or brackets thus presented a big problem in themselves since manufacturers have never apparently considered the desirability of standardizing provisions for bumper mounting. The bumper tests have demonstrated conclusively that brackets holding successfully upon one make of car may fail dismally applied to chassis of different design.

The manner in which the bumpers are treated is rough as one devised by these engineers. Instead of propelling a car at a bumper against a stationary object a stripped car frame equipped with the bumper to be tested as shown in the illustration is bolted rigidly to a cement floor and made ready for the blow.

The blow is supplied by a short length of 24-inch iron pipe filled with concrete and suspended by steel cables from a point 18 feet above the floor.

When this massive pendulum is pulled back from the perpendicular to a distance of 21 feet and released it rudely swats the bumper with a force estimated to equal the impact of a 4000-pound car traveling at a speed of 4 miles an hour.

Under this test many bumpers have come through smiling. When the weight has been swung over a 30-foot arc however not one bumper has survived. They not only crumpled into pretzel-like formations but failed to protect the radiator from damage. This swing of 30 feet incidentally corresponds to the impact of a 4000 pound car running at 8 miles an hour.

A bumper after being tested with a four-mile-per hour blow

The engineers believe that the practice of reversing actual conditions by having the theoretical fire-plug or telegraph pole the moving object while the automobile remains stationary may account for the unexpected seriousness of the test results.

Making Sport a Science

Devices and Tests Which Determine the Individual Fitness of Candidates

By Dr. Alfred Gradenwitz
Berlin Correspondent, Scientific American

WHILE sport in the curriculum of pre-war German public schools played only an unimportant part and was practically excluded from the university college, there has lately appeared among schoolboys and undergraduates a remarkable revival of sporting activities, and inasmuch as everything in the Fatherland is done with commendable thoroughness, sport, formerly looked upon as a rival of scientific pursuits, has lately been promoted to the rank and dignity of a science. In fact, Berlin at present boasts two colleges of sport where everything pertaining to gymnastic exercises and outdoor games, as well as the behavior of the human body under the most varied conditions of physical activity, is investigated, practiced and taught in the same scientific spirit that is so characteristic of higher education at the university.

One of the most important tasks to be solved in this connection is the ascertaining of individual fitness for each kind of sport and the possibilities of the human organism with regard to the developing of this fitness. One of the pioneers in the field of practical psychology, Dr R. W. Schulte, has installed at the College of Sport in Berlin a special testing laboratory for investigations of this sort entrusted to his care. His laboratory comprises a number of his own special apparatus for this purpose.

The football candidate's test. Two hinged doors are placed in front of the ball about to be kicked. After the ball is kicked, the angles of both doors are examined to determine if they are equal or, if not, how nearly accurate the kick was as regards direction

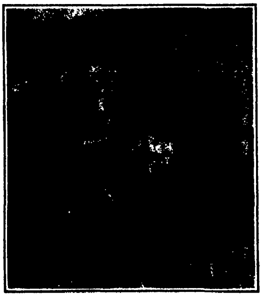
While the medical adviser specializing in sporting problems is mainly engaged in an investigation of the structure, growth and functioning of the organs, the practical psychologist has a still more fascinating, though incomparably more difficult, task to grapple with, viz., the searching of the sportsman's psychic behavior. The psychological diagnosis tries to ascertain, gage and appreciate the various composite psychic characters and capacities, while practical psychotherapy investigates the laws according to which existing capacities are practiced, developed, trained and integrally utilized.

The rule of the selection of the fit applies most strikingly to sporting activities, though there is a natural spontaneous elimination of those unfit for a given sport. In fact, the beginner in the field can from the outset be shown the proper way and thus be saved a useless waste of energy and enthusiasm. After investigating, in the case of highly gifted masters, the capacities required, for example, in football or in boxing or in javelin throwing, the sportsman-candidate's individual fitness and faculties are checked up with the requirements thus ascertained.

The various factors tested at Dr Schulte's laboratory form a list too long to be enumerated. Some of the more important are an examination of the acuteness of vision and sense of proportion, the gauging of distances, the muscular sense and sense of strength in the case of the boxer, the fencer's hitting capacity, speed gaging in the case of the tennis player, calmness and security in that of the gymnast, the sense of rhythm and cadence in the oarsman, the gaging of combination in space in the case of the footballer. Other tests of a purely mental character comprise the testing of the keenness of observation as well as the special type of attention and concentration power required in sports, not only for the sake of the sportsman but for umpire as well. The ascertaining of the individual type of memory and association of ideas is of especial interest, the sportsman's intelligence often being of paramount importance to his individual fitness. Judgment and discrimination, power of rapid combination and presence of mind, an increased adaptability and real ingenuity are among the qualities primarily required in the efficient sportsman.

However, psychic investigation at Dr Schulte's laboratory is more searching still and even comprises an examination of feelings and individual temperament, the intensity and behavior of emotions, personal assurance and independence of outward influences, all of which are by no means neglected by the psychological experimenter wishing to get an idea of the would-be sportsman's fitness. Ambition, emulation, subordination and other psychic characteristics are bound to prove of considerable importance in choosing a given branch of sporting activities. Extremely interesting and striking results are finally obtained by studying the individual's will power; the speed of decision, security of action, continuity of response and coordination of limbs should all be tested more or less in detail. Nor has Dr Schulte been afraid of tackling such a complicated problem as a study of the power of decision in critical and dangerous situations, personal courage and energy, psychical capacity, skill and speed of motion, resistance to fatigue, and training capacity, in their most varied forms.

Left: The boxer's test, which consists of hitting the buffer plate with a series of even blows, the force of each blow being observed and recorded to determine evenness and control. *Right:* Determining the sense of rhythm of an oarsman. The observer sets up a given rhythm by means of a telegraph key, while the oarsman endeavors to follow that rhythm as nearly as possible. A recording apparatus keeps track of the observer's rhythm and that of the oarsman



Apparatus for testing courage or plain "grit" by means of a sudden dose of hot water

As one of the typical instances of the highly varied activities of Dr Schulte's laboratory of sports, there is the football candidate test. The football testing device allows of investigating an important quality required in the practice of the football sport, namely, hitting capacity and the sensitiveness of joints. The candidate is asked to kick the ball lying in front of him in a given, exactly-prescribed direction, any deviation from which is ascertained by the ball forcing apart two side members suitably hinged. When the ball passes straight through these side members or doors, both of them are pushed aside to form the same angle, any difference ascertained between the two pointers enabling the error to be gaged. A third flap provided at the top enables any jerk pointing upwards to be ascertained.

Another apparatus is intended to gage the intensities of jerks in boxing. The candidate is asked to perform against the buffer plate of the apparatus, driving a

(Continued on page 445)

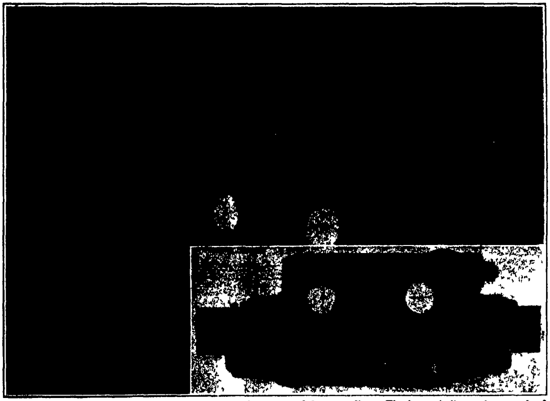
A Milling-Machine Dynamometer

VARIOUS devices have been designed from time to time for determining the pressures exerted by a milling cutter on the various working parts of a milling machine, but up to the present time there has been no mechanism which could be relied upon to give accurate readings of these pressures, so that the designer of the milling machines as well as the designer of fixtures and milling cutters for use on them, have been very much in the dark. It has long been recognized that accurate knowledge in this regard would also be of material assistance to the designer of machine parts which are to be milled, because in the final analysis, the pressure of the cutter is first exerted on the piece itself and merely transmitted from it, first to the fixture and then to the milling machine

Another element on which there is practically no existing knowledge is the difference in pressures exerted by cutters of different form or different design when taking duplicate cuts. It is true that a carefully calibrated machine, equipped with a direct-connected motor drive and ammeter, provides the means of determining the difference in horsepower consumed by various cutters, but means have been entirely lacking for separating the vertical thrust, the horizontal thrust, and the longitudinal thrust, and thus determining the specific pressures exerted in these three directions.

Also, with different combinations of feeds and speeds, the efficiency of the milling machine varies and it is therefore important to have means of determining the actual cutter pressures, entirely independent of the efficiency of the machine or any part of its mechanism.

In order to attain this object, the dynamometer shown in the accompanying illustrations was devised This dynamometer provides means for reading the pressures exerted on any milling cutter while at work, in two directions, the readings being taken direct from the dials shown. The apparatus consists of a working table which is supported by a base plate, which is in turn bolted to the table of the machine The vertical downward or upward pressure of the cutter is read direct from the left-hand dial The longitudinal pressure of the cutter is read direct from the right-hand dial These are the pressures with which the designers and users of milling machines, as well as milling cutters, are most concerned However, if it is desired also to obtain the crosswise pressure, that is, the pressure in line with the milling-machine arbor, as, for example, if it is desired to determine the end thrust pressure, of a spiral milling cutter or a face milling cutter, the dynamometer can be mounted crosswise on the table, and the pressure in question read from the right-hand dial.



The milling-machine dynamometer, as it appears when mounted for a reading. The insert indicates how much of the upper picture comprises the dynamometer itself

The work platen of the dynamometer is supported at each end by a wide plate fulcrum, their lower ends resting on two levers which carry a definite portion of the vertical load on the platen to a hydraulic chamber placed centrally under the work table. This chamber is connected with the left hand gage which is graduated by trial in terms of the vertical load in pounds.

The horizontal load is transmitted through bars which are flexible vertically, to the crosshead seen at the right in our larger photograph, and this crosshead transmits the load to the hydraulic chamber seen between this crosshead and the end of the main frame of the dynamometer This chamber is connected to the right-hand gage by the pipe shown.

The plate fulcrums carrying the loads to the levers are so constructed as to be rigid against vertical and cross loads, but flexible to longitudinal loads, and the bars to the crossheads are flexible to vertical loads so neither system interferes with the action of the other

Heavy springs are used to put initial loads on each chamber so they will show loads in either direction Guards are provided so that any desired lubrication or flooding of the cutter may be used

The dynamometer has the capacity to withstand loads of 25,000 pounds longitudinal, and also loads of 4000 pounds in the opposite direction, vertical down ward pressures of 10,000 pounds and upward pressures of 7000 pounds.

The working surface of the working table is 16 inches long by 10 inches wide, and is provided with three T slots. The height of the working table above the bottom of the base is 8 inches. The total size of the base of the dynamometer is 35 inches long by 14 inches wide

It is obvious that the dynamometer is extremely valuable for manufacturers of both milling machines and milling cutters, as well as for shops where milling operations are studied and given proper attention (as automobile plants and experimental shops), for laboratories and shops of technical schools and colleges, etc. Problems attending standardization of machines and cutters can be more readily solved with its aid.

This instrument has proven extremely satisfactory and very sensitive under tests. Quite obviously its use is not confined entirely to milling machines, but it is equally adaptable for making tests on planers, shapers, and with slight variations, drill presses.

Identifying Animals by Imprints

IN *Discovery* (British) for May, 1923 Mr O A. Mitchell says "The most recent development of the use of imprints from the ridges of the skin has been its extension to the identification of cows. It has long been known that the patterns on the fingers of lemurs and the higher apes may be as complex in their character as the human skin patterns, whereas the patterns of the ridges upon the friction skin of the lower monkeys are much simpler in character In the case of a ruminant animal, such as the cow, it would be useless to look for any characteristic patterns in the hoofs, but, acting on a suggestion sent to me from America, I have made a number of prints of cows' noses, and have found that the arrangement of the sweat pores follows distinctive patterns, which can therefore be used for the identification of these animals The practical value of this discovery lies in the fact that it is not an uncommon practice for one cow to be substituted for another and more valuable one after the purchase has been completed. A registration of the nose-prints of all pedigree animals would therefore prove an effective safeguard against this fraud"

The author is carrying out a further series of experiments to determine whether the patterns are permanent and remain constant in their form over a long period in the growth of the animal, and whether the differences are always as pronounced as in the case of these two animals

It is quite possible that the same method of identification could also be applied to dogs, and if so, it would be a very simple method of establishing their pedigree

Trees and Climate

IN every country a subterranean reservoir exists at a greater or less depth below the surface It is the level of saturation which, of course varies from time to time according to the rainfall At the sea, it coincides with the mean tide level, but it rises more and more on going inland, and it is the level to which wells must be sunk before water appears in them It is caused by the rain which is usually said to run off to the extent of one-third, another third sinks in to form this reservoir and the remainder is lost in evaporation When following a river valley, one often notices a line of springs appearing at a certain level, this is when the valley has been cut down to below the subterranean reservoir, which then forms a wet trough for it to run in When the reverse is the case, the river loses a great deal of its water by its percolating into the dry soil around and beneath it In the East this last is very common, so that rivers very often get smaller and smaller the further they go, till at last they dry up altogether

We see now that the denudation of trees has cumulative ill effects which tend to reduce the fertility of the country The reverse is also the case, a large growth of forests has accumulative good effects tending greatly to increase the humidity of the air, the equability of the temperature, and the fertility of the region. The moisture in the atmosphere, largely supplied by leaves, has a very great, but often unnoticed, effect on a climate. The aqueous vapor is impervious to heat rays, unless they come from a greatly heated source. In fact, it acts in much the same way as glass. The heat rays from the sun pass freely through but when the same rays are reflected back from the earth, the glass or the water vapor acts as a screen to them The atmosphere in this case is just a blanket like the roof of a greenhouse, with all the benefits which naturally accrue from it. This is the main reason why moist climates are so much more equable than dry ones. In a desert the day temperature often rises to 120 degrees or even 140 degrees Fahrenheit in the shade, while at night it may fall below the freezing point. In a moist climate in the same latitude the daily range will be perhaps from 80 to 85 degrees shade temperature in the day, and 65 to 70 degrees at night The hotter the climate the more marked are these effects. In the moist climate of Bengal, in the forested parts, the thermometer scarcely ever reaches 90 degrees in the shade, whilst at night it is rarely below 80 degrees. In the same latitude in Bikaneer Desert or in the Sahara, the temperatures have a diurnal range of perhaps 70 degrees or 80 degrees instead of 10 degrees, and this is entirely due to the absence of moisture in the air It follows, then, that the hotter the climate the more careful man should be to preserve his trees, but unfortunately exactly the reverse is usually the case either from ignorance, want of fuel, or shortness of pasture—*Abstract from article by Col. H de H Haig in Discovery (British) for May, 1923*

The Carlsbad Cave

Recently Explored Cave in New Mexico Which Rivals, If Not Excels, Mammoth Cave of Kentucky

By F Le Roi Thurmond

IN THE Guadalupe Mountains of New Mexico, twenty-four miles from Carlsbad and ten miles from the Texas line there is a cave in limestone of Carboniferous Age, rivaling, if not excelling, the Mammoth Cave of Kentucky in the variety and unique forms of its stalactites and stalagmites, and in the great dimensions of some of its chambers.

One of the many caverns of the Carlsbad Cave, located near Carlsbad, N. M., showing the beautiful stalactites and stalagmites

The cave in question is little known, never having been fully nor officially explored, nor even exploited as a natural wonder Its chief interest has been that it contained quantities of guano from the excrement of bats, valuable as a fertilizer because of the phosphoric acid and nitrogen it contains.

The "Bat Cave," as it is known locally, was discovered in 1901 by J L. White and Bige Long, who were hunting deer when they observed a great swarm of bats coming out of a hole in the bed of a shallow ravine Descending by means of ropes, they found a gallery running for miles to the westward, and about two hundred feet deep, where the descent was made The floor was covered with blocks of limestone which had sloughed from the ceiling Myriads of bats clung to the walls and ceiling, where they hibernated during the winter months, emerging only on summer evenings to feed on flying insects.

The cave was shortly afterwards exploited for the guano, the product being shipped to California, where it was manufactured into fertilizer, or applied in the natural state to the soil of orange and other fruit lands.

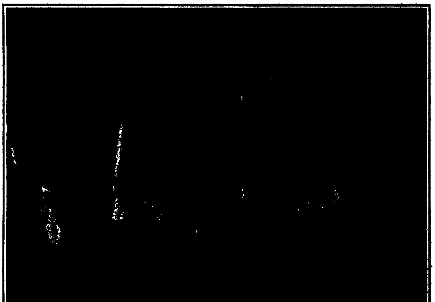
The writer, in company with Mr White, one of the discoverers, recently visited the cave and spent seven hours underground This time, however, was sufficient to visit only about a quarter of the known parts of the cave

The cave is entered by means of a bucket attached to a cable and operated by a hoisting engine The descent is 180 feet The part of the cave near the entrances—there are three of them in a half mile—is the oldest in point of development and decay because, being close to the surface, the rock above is not thick enough to retain sufficient water continuously to cause the steady drip into the caverns below, but fragments of broken columns in the debris underfoot indicated that these chambers were once adorned with many large stalactites and stalagmites before erosion had removed the great thickness of limestone above, and earth movements had shaken them down with the masses of limestone which covered the floor to an unknown depth

Traveling westward through a series of chambers which widen and narrow, sometimes climbing or descending steeply for several hundred feet, we reached an estimated depth of 750 feet, about one and three-quarter miles from the portal

Here were a number of chambers known as "The King's Palace" Surely it was a palace fit to house a king of the underworld! In one of these crystal laced chambers one might discover a sleeping princess ensconced upon a jeweled couch Other chambers of greater size might have been plutonic council halls, grotesque thrones surrounded and canopied with crystal forms as curious and weird as ever conceived by poet or drunken brain. The imagination, unlabored, might discover gnomes and trolls and all the queer little people who live in the sublight of poetic fancy.

Here was a study in the action of ground water in dissolving the calcium carbonate of the limestone and redepositing it in these grotesque and beautiful forms. This part of the cave is alive and active today, water dripping from and slowly depositing a part of its burden upon the innumerable stalactites, and a further quantity of it upon the stalagmites, which, through centuries of centuries, grow toward each other until they meet and coalesce in columns of exquisite form and marvelous beauty Numerous factors are involved in creating the varied forms; stalactites—slender, cylindrical and fragile, or conical, massive or finely tapered; stalagmites like the petrified stumps of trees, or domes, minarets and spires.



Another view in the Carlsbad Cave. One room alone in this cave is estimated to be one mile long and one-quarter mile wide with ceiling 100 to 300 feet high

A fascinating aspect of the pendent forms is the wonderful musical notes given out when they are caused to vibrate Striking lightly with a broken fragment will produce notes of marvelous purity, notes as delicate and sweet as those of a bird, or deep and sonorous like the pipes of an organ.

Lack of time prevented further exploration. However, according to Mr. White, there is a chamber some three-quarters of a mile to the westward, six hundred feet wide and five thousand feet long. This is probably the largest known chamber in any cave. There is also an underground stream and, seven miles from the portal, an abrupt cliff Beyond this, nothing is known. As far as the actual dimensions of the various chambers are concerned, present figures are little more than more or less careful guesses.

"How was this cave formed?" a member of the party asked.

"Do you see that rusty streak in the roof where it is low enough to be illuminated by the torches?" replied the geologist. "There is your answer. That streak is the line of a fault Water charged with carbon dioxide has moved downward and along the plane of the fault, dissolving and carrying the calcium carbonate of the limestone with it.

"'And did you notice before we entered that the portal was in the bed of a ravine or draw? That ravine is the surface expression of the fault, and, after having been formed by erosion, it facilitated the formation of the cave by capturing the surface water, where it flowed parallel to and directly over the fault."

The importance of this cave as a natural curiosity has been discovered by the Department of the Interior, which is now engaged in surveying and mapping, with a view to creating it and an adjacent area a National Park for the enjoyment of the whole people.

Edison's First Incandescent Light

AT the present time, according to a "History of the Electric Light" issued by the Smithsonian Institution, there are 350,000,000 incandescent lamps in use in the United States and about an equal number in use in foreign countries.

When Edison first began the study of the incandescent light in 1879, there were several commercially established arc light systems in use in the United States. All these systems operated on the "series" system, the only system for distributing electricity known at that time. In this system current generated in the dynamo armature flowed through the field coils, out to one lamp after another over a wire, and then back to the dynamo. There were no means by which one lamp could be turned on or off without doing the same with all the others on the circuit. Edison realized that while this was satisfactory for street lighting, where arcs were generally used, it never would be commercial for household lighting. He therefore decided that a practical electric lighting system must be patterned after gas lighting, with which it would compete. He therefore made an intensive study of gas distribution and reasoned that a constant pressure system could be made similar to that of gas. The first problem was therefore to design a dynamo that would give a constant pressure instead of constant current.

After many experiments, Edison was successful, and in 1879 he made a dynamo which met every requirement and, in the same year, a carbon lamp in which the filament consisted of a carbonized piece of ordinary thread. On October 21, 1879, current was turned into the lamp and it lasted forty-five hours before it failed. A patent was applied for on November 4th of that year and granted January 27, 1880. All incandescent lamps today embody the original features.

Tested for a Million Volts

ELECTRICAL testing on a huge scale is provided for in the factory at Freiburg, Saxony, where porcelain insulators for the continental market are produced. A gigantic experimenting stage has been erected, specially designed for the testing of the porcelains under voltages of a million or more. An idea of the size of this testing-stage, as well as some notion of the magnitude of electric discharges at this high potential, may be got by looking for the man in our photograph.

German plant for testing porcelain insulators at high voltages

A Gasoline Rail-Car of Power and Stability

MORE difficult than the problems presented to most gasoline rail-cars are the operating conditions on the Nevada, California and Oregon Railway. The track is of the narrow gage of three feet, which would make it seem almost inevitable that stability would suffer to some degree. The altitude ranges from 4500 to 5500 feet above sea level, at which the air is appreciably lesser in oxygen than in most places where automobiles do heavy duty. But the vehicles illustrated herewith have been conspicuously successful under these conditions. On the fastest trip recorded, a 100-mile stretch was made at an average speed of 35 miles per hour, negotiating grades as steep as 2½ per cent, with 28 passengers. Speeds as high as 55 miles per hour have been attained. On the initial run of 520 miles the gasoline cars average 11 miles per gallon, and refilling the radiator and crankcase called for the addition of only one quart of water and one pint of oil.

These cars are 32 feet long, over all, and eight feet high from rails to roof. They are operated, like any well conducted automobile, by a single man, from the front end. They carry four-cylinder motors, 4½-inch bore and six inch stroke. The motor is placed behind the rear axle, eliminating all revolving parts in front of that point, and enabling the car to be hung very low—14 inches from top of rails to floor of car. Also, the noise and dirt of the motor are left behind on the right of way to a very large extent through this construction. The car weight is 10,000 pounds. The cars are built by a commercial concern, and are available in even narrower gages than the one used on this line. In all sections of the country, the railroads are turning to the gasoline car as a means of meeting the problems of the short line and the line on which traffic is not heavy enough to support the conventional steam train. Gasoline-car manufacture will doubtless become a growing specialty in the presence of this newly created demand.

Narrow-gage rail-car whose gasoline-driven motor is located behind the rear axle

To Prevent Lamp Thefts

RAILROAD companies and other large users of electric light bulbs are up against the problem of preventing the bulbs from being carried off surreptitiously by persons who prefer to get their bulbs for home use in this way rather than pay for them. A writer in the *Electric Railway Journal* of June 15th, discusses the several possible plans which have been tried to discourage the practice.

The simplest of these, although probably the least effective, is to mark the lamps in such a way that they are easily identified.

Another plan is to use a base that will not fit a standard fixture. A third expedient is the employment of a lock socket. Lastly, it is possible to use a lamp of unusual voltage, which will thus be too high or too low for common use, hence there will be no temptation to steal it.

One variation of the "different-socket" plan is to employ a socket with a left hand thread. Incidentally, this is the method used by the New York City Interborough Rapid Transit R. R. to prevent the 40-volt emergency lamps from being used in place of the regular 130-volt bulbs; the former, having left hand threads, will not fit any socket except those especially intended for them. Another variation of this idea is the use of a lamp with a bayonet base, as sockets to fit such bases are practically unavailable to the general public.

However, probably the most effective and most practical plan so far tried has been that of the lock socket. The lock socket is difficult (although not impossible) to remove without the key. Moreover the very fact that it is locked acts as a deterrent.

One form has a "dog" which is pivoted so as to permit the lamp to be inserted without difficulty but which "bites" when an attempt is made to unscrew the bulb. It is easily unlocked, however, with the proper key.

The Brooklyn Rapid Transit Co. has adopted a form of lock socket which has an interior shell that turns freely within the outer casing; consequently the lamp cannot be unscrewed until the key is inserted to engage the slotted base and thus prevent rotation. As the socket simply turns the thief is not tempted to apply brute force to the lamp.

Better "Gas"

A SURVEY just made by the Bureau of Mines shows that there has been an upward trend in the quality of gasoline sold at the curb in several well distributed cities of the United States. The "gas" vaporizes easier. This is the quality the motorist most wants, especially in cool weather when the rhythmic rasping of the self starter is so persistently heard. Contrary to general belief however, there is little difference in actual power value between the low and high volatile gasolines, and this difference favors the low volatile fuel. When one descends along the scale to kerosene the fuel value is higher than gasoline. However in common practice the gas of high volatility is more eagerly sought than the low, both for the reason that it enables easier starting and because in the average motor it is vaporized better and the motor has a harder "kick." After all, it is not the theory but the kick of it that we want.

High-Altitude Tests Without Leaving the Ground

OUR cover this month shows the testing chamber for prospective aviators now in use at the French experiment station at Bourget. This chamber is intended to show what will happen to the candidate's respiration and to all his other anatomical functions at high altitudes. The atmosphere in the chamber is exhausted to a point corresponding with the altitude for which the test is to be made. Every provision is made for effective use of the apparatus. Thus, while there is naturally no escape for the unhappy candidate until the test is completed, it is recognized that the examining doctor himself may be less efficient under high-altitude conditions than normally. The matter of pressure is perhaps not so serious under this head, but that of oxygen is; so the doctor wears an oxygen mask that insures his normal respiration. All the controls for the apparatus are in duplicate, one set being inside the test chamber and one outside, so that the entire operation of the test may be regulated from within or from without.

Better type of portable grandstand, developed by New York's municipal engineers

Portable Grandstand of Structural Steel

A NEW portable grandstand has recently been developed by the Department of Plants and Structures of New York City. The framework of the stand is built of structural steel units 5 feet long and 1 foot 5 inches high. The units are assembled to form the risers of the stand. Car bolts are used to fasten the sections together. Longitudinal sway braces of 1¼ inches by 1¼ inches by 1¼ inches angle iron are bolted in between opposite panels of adjoining risers as the stand is erected. The risers are spaced 5 feet apart. The flooring of the stand is made up in sections 1 foot 8 inches wide and 10 feet long, secured to the risers by clips which extend under the flange of the top angles of the riser frames. The seats are supported on pipe pedestals bolted to the floor sections.

The method of construction eliminates a great deal of the liability of the stands to collapse, and provides clean seats separate from the platform. Erection and demolition are very much more expeditious than with the more familiar type of portable stand.

The "Horse-Hair Snake"

An Account of the Extraordinary Life History of One of Our Common Worms

By Leon Augustus Hausman, Ph.D

Assistant Professor of Zoology, Rutgers College

WITH the inquiries of modern biological science into the life-history of the "horse-hair snake," another of those pleasing fancies of our childhood (i.e., that horse hairs placed in a tub of water would turn into snakes, is forced to take its place in the realm of the fabulous. In this instance, however, science supplies us with a story concerning the life of the horse-hair snake far more extraordinary than that of which her researches have deprived us.

The belief in the transmutation of inanimate objects into animate beings is as old as the human race. The belief in the transmutation of horse hairs into snakes is perhaps the last to lose its hold We find mention of the horse-hair snake in Shakespeare's "Antony and Cleopatra," Act 1, Scene 2

"Much is breeding,
Which like the courser's hair, hath yet but life
And not a serpent's poison "

Sir Thomas Browne (1605-1682) in his celebrated "Pseudodoxia Epidemica,' or Vulgar Errors, of his time, does not list this notion as erroneous, and since we may not suppose that so scholarly and singularly acute a collector of contemporaneous superstitions and legends was ignorant of the belief in this transmutation, we may infer that he also gave it acceptance. In view of the surprisingly intricate life history of the horse-hair snake it is not surprising that the belief in its miraculous metamorphosis from a horse hair has lasted well down into the twentieth century, and still persists in remote rural districts, and among children, to the present day

The hair snakes, or hair worms, as they should be more properly termed, belong to the Family *Gordiidae*, and the Genus *Gordius*, a group of animals placed very low down, in the ascending scale of animal life, or to be precise, between the Flatworms (of which the liver flukes and tape-worms are representatives) and the Starfishes, Sea Urchins, etc They are not as formerly supposed, at all allied to the higher worm forms, such as the common earthworm. The hair worms resemble

Fig 2—Mass of Gordius twining together in a typical "Gordian Knot" amid water plants

nothing so much as animated horse hairs (Fig. 2.) They are slender black, brownish or yellowish forms, from three inches to a foot in length, and slightly tapered at either end. Roadside ditches, pools, old watering troughs, and the shallow edges of small lakes and ponds are their favorite habitats (Fig 1) They seldom inhabit running streams. When active they are engaged, usually, in making their way slowly and apparently rather ineffectively through the water by a languid undulatory motion of the slender body, or writhing about among submerged vegetation. Frequently many individuals may be found intricately knotted and twisted together into a ball, sometimes to the number of a hundred or more, which being reminiscent of the famous Gordian knot of Alexander the Great, has given the family its name Great numbers of Gordian worms often appear suddenly in pools and ditches which just before, were apparently free from them, and following such appearances tales have sprung up attributing their presence to a rain of worms.

The female *Gordius* distinguished from the male by her acuminate, instead of bifurcated tail, after fertilization deposits her very minute eggs (which are sheathed in a long delicate gelatinous strand resembling a sewing thread) on the stems and leaves of submerged aquatic plants (Fig. 3) Before fertilization both sexes are round, but become flattened after the loss of the genital products.

After about four weeks there develops from each egg a minute larva, about 1/450 of an inch in length and vastly unlike the parent, having a segmented body, and bearing on the head a formidable protrusible boring apparatus consisting of stiff chitinous rods. About the base of the boring proboscis is grouped a series of tubercles each bearing a decurved spine. This creature

Fig. 1—Roadside ditches, a typical Gordius habitat

Fig 6—Predaceous ground beetle (Harpalus), within whose body the Gordius young grows to maturity after leaving the Mayfly larva

swims about actively in the water for a short time, and then bores its way into the soft parts of the body of some aquatic nymph (i.e., young of an insect), very commonly selecting the nymph of some common Mayfly (Fig 5) Within the body of the young Mayfly the *Gordius* larva loses its boring proboscis and its tubercle-bearing spines, the posterior portion of the body elongates, and the creature grows into a young hair worm At this stage it leaves the body of its first host, in a rather dramatic manner, and takes up its existence in the body of its second host This second host is often the common *Harpalus* beetle (Fig 6), and the transference of hosts comes about as the result of the devouring of the first host by the second! Within the body tissues of the *Harpalus* beetle the young hair worm completes its growth, and later emerges and escapes into the water in the form in which we are accustomed to see it.

There are many vicissitudes in the life of the hair worm Upon the emergence of the larva from the egg it must first escape the devouring maws of numerous fishes, and the gullets of a vast host of lower forms of aquatic life. Its first host, the Mayfly or other nymph, must then be stranded upon dry land (commonly by the drying up of the pool), and next must fall a prey to a hungry *Harpalus* beetle. The hair worm must, in its transition from Mayfly to beetle, evade the cutting mandible of the latter, and be lodged unbitten, within its stomach. Upon arriving at maturity within the body tissues of the beetle, the hair worm must trust to luck, of a seemingly most capricious sort, to be carried into the immediate vicinity of water. Without the close proximity of water, upon its emergence from the *Harpalus*, it would die at once Only those worms whose hosts fall into the water or are carried away by floods, probably ever arrive at full maturity

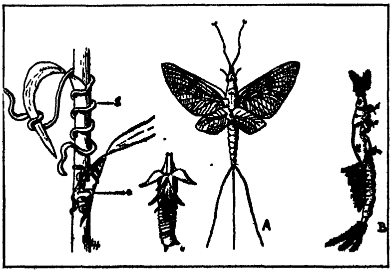
It will be seen that the chances of the particular sequence of circumstances favoring the growth of any individual larva into a mature hair worm must be very meager indeed, and only a very minute proportion of hair worm larvae probably ever complete their life cycle Indeed, if we contemplate the dangers of destruction which the hair worm must avoid on its journey from youth to maturity it seems truly miraculous that any should be able to make the journey, and reach the goal of all life, the period of sexual maturity and reproduction.

Only the most important of the dangers of destruction are here listed, there must be many more of which we have little knowledge It may be because of the unusually large number of hazardous vicissitudes in the life of the hair worm that there has come about a very interesting and unusual functional adaptation of the genitalia, whereby the worms are able to reproduce themselves before they become fully adult in their other body structures. Another apparent provision which nature has made as a counterbalance to the great mortality of the hair worm, is the remarkable ability in egg production. It has been estimated that as many as six million eggs can be laid by a female in one season!

While the larvae feed upon the fatty portions of the bodies of their hosts, the adults take no food, and indeed, can take none, for the mouth is functionless and is stopped by a cuticular plug Thus the adult life is merely a short period for mating and egg laying, and the hair worm passes the greater part of its existence as an internal parasite From one to five individuals have been found in some insects, and during the last stages of their existence as internal parasites the worms may be coiled up among the viscera of their hosts, and may even extend through the thorax and up into the head! The weight of the worms is often greater than the combined weight of all the internal organs of the host!

Hair worms have also been found in the bodies of crickets and grasshoppers, forms which feed upon vegetation In such cases the hair worms may have become prematurely freed from the bodies of their hosts by the death and disintegration of the latter, and consumed with the foliage on which they may have fallen The presence of hair worms, likewise, within the bodies of snails, of the higher vertebrates, and even of man, is probably also to be ascribed to accidental ingestion.

Much investigational work still remains to be done in this fascinating little corner of biological research



Figs. 3, 4, and 5—Female Gordius twining about the stem of a water plant and laying eggs. g: Gordius; e: eggs. The adult A and the young or nymph B of a common Mayfly. It is within the body of the latter that the free-swimming larva of Gordius passes the early stages of its life

Where Bridges Are Built in the Dead of Winter

THE Tanana River Bridge, recently completed as the last link in the Government's Alaska Railroad, is unique in several respects. Measuring 700 feet from pier to pier, it is the second longest single-span railroad bridge, being exceeded only by a similar bridge in St. Louis. Approximately fifty miles from Fairbanks, the "Golden Heart" of Alaska, it is the farthest north of big bridges. It was constructed in the dead of winter, with a temperature running for days at a time between 50 and 60 degrees below zero.

With its completion, the Alaska Railroad now operates on a standard-gage track from Seward, an all year-open seaport, to Fairbanks on a two-day, all-daylight schedule. Before the bridge was completed, narrow gage was used from the north bank of the Tanana river to Fairbanks, with standard gage from Seward to the south bank of the river. Crossing of the river at Nenana was made in summer by two ferryboats, the "Midnight Sun" and the "Matanuska." In winter, when the ice in the river froze to a thickness of three to four feet, a narrow-gage track was laid on the ice and trains from the north side were brought across the river to meet the standard-gage trains on the south side. As the time for the spring breakup approached, the tracks were taken up and dog teams and sleds were used to transport freight and passengers over the crossing.

Erection of the main truss took place during the cold est weather in Alaska, when, for short periods of time, the temperature drops as low as 50 or 60 degrees below zero. As the ice goes out of the Tanana river not earlier than May 12th, if the bridge were built during the summer it would be some time in June before falsework could be established across the river, which would leave but a three months period before the "ice run" in the fall of the year. In addition, falsework would be endangered during the summer months should one of the big floods take place. These occur frequently, carrying driftwood as large as full sized green cottonwood trees, with roots and branches intact, which have been swept away by the flood in the process of bank erosion. As the formation of solid ice usually is complete by the end of October and it remains in place until May, this six-month period was selected in which to erect the bridge and remove the falsework.

The bridge was built at a cost of $1,084 412 42, including the cost of changing the line of approach and transportation of material. This is approximately $200 000 less than the initial estimate. The total length end to end of steel is 1302 feet, and the total length from the south end of timber structure to the face of the parapet of the north abutment is 4183 feet. The bridge has a clearance of 47 feet above mean summer high water, which is ample for river steamers designed to proceed beyond Nenana to the upper river. The single span of 700 feet, crossing the river from shore to shore, makes the bridge oblivious to any ice movement in the spring breakups.

Nenana, the townsite at which the bridge is located, is a transfer point for shipments down the Tanana and Yukon rivers, and the Alaska Railroad has established a joint tariff on freight shipments from river points to Tacoma or Seattle. The first large shipment, consisting of several carloads of high grade lead-silver ore, was received at Nenana early in June.

Fairbanks, the interior terminus of the railroad and the center of lode and placer gold mining, is now in almost daily communication with the outside world. Prior to the advent of the railroad it had to depend on dog sleds in winter and the only less uncertain river boats in the summer.

The Tanana River railroad bridge in Alaska, of a single span to make it safe from ice and freshets, and built during the winter while the river was heavily frozen over

The three-foot concrete footings on which rest the expansion seams

The Largest Swimming Pool for Ten Thousand Swimmers

THE largest swimming tank in the world has just been completed in San Francisco as an integral part of the great park and playground program planned for this city. It is of reinforced concrete, 1000 feet in length and 100 feet wide except for a center portion which measures 150 feet across. Accommodating 10 000 swimmers, it cost approximately $80 000. The tank is located about three miles south of the Cliff House and about 150 yards from the ocean. The fact that ocean water is to be used in the pool, with its salt-water content, has necessitated many special features of construction.

The bottom of the 14-foot diving pool, showing the flow of ground water which has to be taken care of

Excavations for the tank were made entirely in sand. Eight inch drain tiles were placed below the bottom of the tank for the purpose of taking care of the hydrostatic pressure. These tiles drain into three fresh-water wells, from which the water is pumped by electrically driven pumps and used for irrigating the municipal golf grounds about a mile and a half distant. The hydrostatic pressure is very great, as the level of the ground water is the same as that of the salt water in the pool. If provision had not been made for pumping this fresh water from under and around the pool, the concrete bottom would bulge upward when the pool was emptied.

The bottom of the tank is interlaced with expansion seams running longitudinally and transversely the longitudinal seams being 42 feet apart. These expansion seams rest on five-inch reinforced concrete footings, three feet wide. This footing has been given sidewalk finish and painted with coal tar to permit a bond between the floor slab and footing, thereby making expansion possible without disruption of either floor slab or footing. The expansion joints are calked with one-inch spun oakum, and the remainder of the seam poured with plastic asphaltic cement. To the concrete mixture was added hydrated lime (equal to 5 per cent of the weight of the cement) as an integral waterproofing of the mass concrete.

The floor slab is five inches thick—4½ inches structurally and one-half inch cement finish on the inside. The cement finish was made by using a 1 2 mix Port land cement mortar, to which was added for each sack of cement five pounds of a waterproofing compound. The entire inner surface was finished with this mixture to overcome the chemical action of the salt water on the concrete and to give a smooth and even finish to the interior of the tank, thereby preventing possible growth of algae.

The walls are divided into 60-foot sections at which points there are expansion joints consisting of wedge-shaped joints, forming a key which interlocks the two wall sections. The seam is composed of five strips of expansion seams and two 4½ inch 13-gage copper sheets, put in to eliminate any possible chance of the penetration of salt water from the pool into or through the concrete, and also to prevent ground water from entering into the concrete at the joints.

The swimming pool is filled with ocean water pumped by a 12 inch centrifugal pump with a capacity of 5,000 gallons of water per minute. The water is pumped through a 10-inch steel pipeline 750 feet in length extending 200 feet beyond the zero tide level and resting on a concrete pier thus assuring clean ocean water at all times. The tank is drained by gravity, the water passing out through the 10-inch steel pipe. However five feet of the 14-foot diving pit will be drained by a special salt water pump (as the diving pit is below the level of the sea) thus making a total of six pumps that will be necessary to operate the pool. The swimming tank will hold 6,300,000 gallons of water.

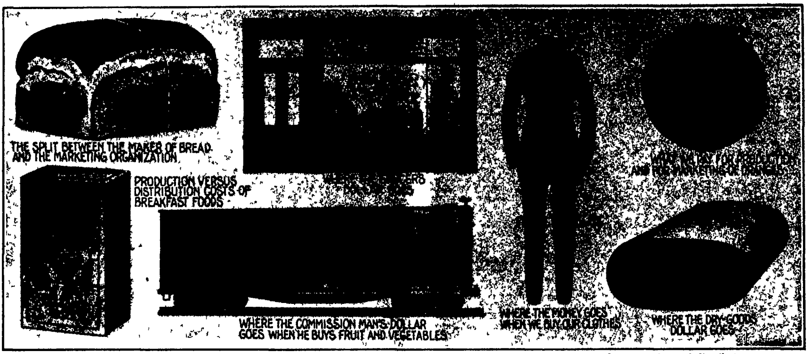
Nature May Have Something Else Up Her Sleeve!

OIL wells, which as all the world knows, produce crude oil—and some of them a very low grade of crude at that—can produce something else.

At least, one well can, and is doing it steadily day by day. That is a well located on Swaggart farm, a mile east of Deer Creek Grant County northern Oklahoma. This well is making about 1500 gallons of pure high gravity gasoline testing 70 gravity, every day at 4000 feet. The owner of this well has taken the opportunity to tank the daily production and put it on the market at 10 cents a gallon. It is being sold to scores of Grant County truck and touring car owners, who formed a waiting list soon after the well started making gasoline.

Natural gasoline is not unknown to the oil industry—in fact, what is known as natural or casing head gasoline is an important end of the oil business. However in this case the gasoline flows from the well and is not recovered or collected from the gas flow as is the case with ordinary casing head gasoline.

Geologists differ as regards geological conditions responsible for the gasoline flow, except to declare that conditions underground must have been such as to perform in a certain manner the refining process which man ordinarily uses to extract gasoline from crude oil. At any rate, the well owner and the public which buys the gasoline have reduced the complicated oil business to a simple thing in this case, whereby the production refining, transportation and marketing of gasoline are completed practically in one operation. No other wells of the Deer Creek field produce other than a fairly good quality of crude oil.



Graphical display of the way in which the dollar with which certain commodities are bought is split between producer, carrier and distributor

The Science of Distribution

An Authoritative Survey of the Devious Channels that Lead from Producer to Consumer

WHEN our grandfathers wore homespun clothes, raised most of the food they ate and chopped the wood for their home fires, the cost of distributing the essential commodities was practically nil But

Cities grew and became the market places of agriculture Inventive genius perfected machines to relieve more and more hand labor and to produce goods in greater volume Working days became shorter and time and opportunity for recreation became greater Education and travel created a desire for comfort, convenience and refinements not dreamed of in earlier generations. Invention after invention revolutionized habits and customs. Electricity added to the length of the day by lighting cities and providing means of rapid, comfortable locomotion Telephone and telegraph extended communication and nationalized industry, commerce and finance

"Refrigeration revolutionized the transportation and storage of food products and changed the living habits of the Nation Fruits, vegetables and fresh meats were transported to distant markets, the production of the whole country was made available to the large consuming centers and crops of seasonal production were offered to consumers throughout the greater portion of the year The consumer came to accept unusual service and convenience as a matter of course and finally to demand more Each new service and convenience drew additional people into the activities of distribution Time-saving, convenience, comfort and satisfaction became the determining factors in the excellency of service More and more facilities were created more and more people were engaged with a constant upbuilding of expense, until *we now have reached a point where it costs more to distribute and serve than it costs to produce*"

The above is not the work of an imaginative writer, but is quoted from the report of a Congressional commission This "Joint Commission on Agricultural Inquiry" has just completed the most remarkable document of the kind ever compiled Congress in the rôle of scientific investigator is at least something of a novelty But this report assumes the dignity of Science nothing less.

For the first time it lays before us accurate figures and facts on the cost of producing and distributing a great many of the commodities we have come to regard as essential For the first time we are given a basis for sound judgment on such mooted questions as "the high cost of living" and "profiteering," and, as might be expected, the average conceptions on these questions are far from anything warranted by the facts For the first time we are given definite conclusions on how conditions may be bettered—conclusions arrived at by the same methods used by the bridge builder for determining the structure of a truss or the size of the foundation

This knowledge has been gained with the most painstaking care. When the committee was appointed, with Representative Sidney Anderson of Minnesota as chairman, it was instructed to investigate "the present condition of agriculture, the cause of the difference between the prices of agricultural products to the producer and the ultimate cost to the consumer, the comparative conditions of other industries and the prices of other products, and the marketing and transportation facilities of the country" Similar investigations have been ordered before, they have come rather to be expected as a graceful gesture on the part of Congress, even though they mean little or nothing But this commission was nothing if not thorough

The first difficulty encountered was the rather startling discovery that "there were practically no fundamental data of a government or public character with respect to marketing and distribution, and it was therefore necessary for the Commission to undertake a pioneering effort to secure from original sources the basic facts upon which a consideration of the problems of distribution might be predicated"

With a view of securing technical assistance and to secure the cooperation of the trades affected the Commission set up in each trade or industry a committee whose function it was to assist the Commission in securing and correlating the information desired from the trades For instance, the Commission set up a retail grocers' committee, a food manufacturers' committee and similar committees in the trades dealing in dry goods, clothing, shoes, hardware, meats, etc.

With the assistance of these committees, questionnaires were worked out, designing to reflect, over a period of years beginning with 1913 and ending with 1921, the actual price ranges of representative commodities distributed by these trades These as far as possible reflected the portion of the consumer's dollar taken by each distributor, manufacturer or producer In this way it was possible to check the figures submitted in the questionnaires of a given trade with the figures submitted by other factors in a chain of distribution and to obtain substantial accuracy in the figures obtained through the questionnaires. Fifteen thousand questionnaires were sent out and returned, covering a total of more than 200 commodities.

A single instance will illustrate the effort that went into the report The committee on department stores, at its own expense, rented two floors of a New York skyscraper and installed there a large force of accountants and assistants, who worked steadily for some months assembling and condensing the facts about department stores The final result was a table of figures, which occupies just one page of the voluminous report. And yet that table contains facts which never before were available, which were invaluable in reaching a final conclusion.

And what of the facts as finally adduced? Are they worth all of this trouble? Is there really anything wrong with our system of distribution? If so, what is it, and is there a remedy?

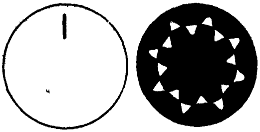
The facts show unquestionably what we have only surmised before that in many details our system of distributing the common commodities of life is wrong For instance, of each dollar spent for bread in the United States in 1921, only about fifty cents represents the actual cost of the bread, baked ready for your table The other half of the ultimate cost represents what was spent on service, transportation and selling costs in *getting the loaf from the bakery to your table*

Of each dollar you spent for rolled oats in 1921 only 30 cents went to the maker for his completed, boxed product. It took 70 cents to transport and sell the oats to you A dollar's worth of oranges cost only 41 cents to produce and harvest ready for market Of each dollar you spent for clothes, 31 cents went for the cost of distribution—the cost of selling the clothing to you Of every dollar spent for shoes, 28 cents went for distribution

The freight bill on a carload of cabbage shipped from Texas to the big Northern markets was about six times as much as the *original value of the cabbage in Texas.* Most of the fruits and vegetables from California, consumed in the East in such large quantities, incur freight bills as great as or greater than their first value. An investigation of 9476 representative carloads of fruits and vegetables sold at wholesale in Boston, Chicago, New York, Philadelphia, Pittsburgh and other large cities showed that about 60 per cent of the wholesale price was paid by the shipper for the commodity, that about 32 per cent went for freight charges, about 2 per cent for miscellaneous handling charges and about 2 per cent for profit.

Incidentally, the profiteering bugaboo which has been raised in the last few years has been roughly handled In nearly every line examined there is a definite trend toward smaller and smaller profits. Indeed, during the period of highest prices, when the cry of profiteer was loudest, many industries sustained a loss. In 1913 the profit to the manufacturer on canned milk was about 12 per cent. In 1918 the profit was a fraction of 1 per cent, in 1920 the industry showed a loss of 3.15 per cent and the profits in 1921 were about 4 per cent. Most other commodities followed the same trend. Undoubtedly, in many cases, the charge of profiteering

(*Continued on page 445*)



The mounting of the neon tube on the disk (left), and the visible indication of the wave-form of the current supply that is secured on rotation

Recording Alternating Current Wave Forms

AS is well known, the recording of wave forms of alternating current supplies is in these days an important process to the electrical engineer. Various types of oscillographs have been devised and applied for the purpose, but all are relatively expensive and complex pieces of apparatus. On the occasion of a visit to the recently opened research laboratory at Wembley, England, a new and very simple apparatus for tracing wave forms was shown. The apparatus is based on the use of the new discharge lamps containing neon gas. Under certain circumstances when the electrodes are in the form of straight wires the length of the wire covered with luminous glow is proportional to the current passing. Hence at any instant the length of the glow in the tube is proportional to the voltage applied. Accordingly, if the tube is mounted radially on the circumference of a rapidly rotated disc one sees the wave form outlined as a patch of light, a series of images being formed round the edge of the disc. The accompanying diagrammatic sketch shows the position of the tube and the resultant effect on rotation.

Amateur Photomicrography by Means of a Microscope and Hand Camera

PHOTOGRAPHY through the microscope is at present an art of the professional world only. It is seldom heard of among amateurs, and yet such photography is one of the best instances in which the ordinary camera can be employed in exceptional work. With a little care a stock camera and a microscope will give remarkable results, providing that sharply defined subjects are used.

The camera should be supported firmly, its lens resting on the eyepiece of the microscope, so that the film is parallel to the object to be photographed. It is well to wrap tinfoil about the connection of the lens and eyepiece to avoid possible interference by light.

Successful results were obtained from a standard make of camera which takes pictures three and one-half by four and one-half inches. It has an anastigmatic lens and an ordinary timer. The focal length of the lens is six and one-half inches. The microscope used had objectives of four and sixteen millimeters, and a 7.5 eyepiece, giving magnification between one hundred fifty and three hundred fifty diameters.

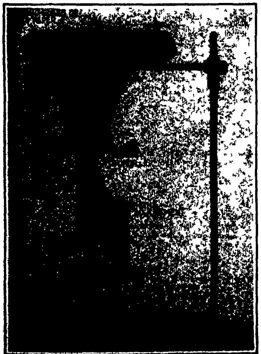
Lighting is the most important consideration of actual picture taking. Experiments proved that the best pictures were produced by intense sunlight (more powerful than is comfortable for the eye) directed on the slide by the concave mirror of the microscope. Owing to the fact that the light rays are tempered by both the lenses of the camera and the microscope, the film is not as violently affected as might be supposed. The direct sunlight enables the operator to take snapshots instead of time exposures, thus eliminating failures due to vibration, movement of the camera or movement of living subjects such as animalcules and diatoms. Of course, opaque subjects require longer exposures and a light thrown on them from above, but for ordinary objects only one-tenth to one-twenty-fifth of a second exposure is required.

In focusing the camera a good plan is to remove the back of the instrument and insert a piece of ground glass or, lacking that, an oiled paper, where the film lies, as is done with a plate camera. The image will fall clearly on the ground glass if no bright light falls on it from above. Adjustment is easily made by setting the camera into rough focus. Sharp focus is then procurable by using the fine adjustment on the microscope and examining the image with a hand glass for detail. The best results were secured when the camera was set for fifty feet. The smaller the distance for which the camera is set, the larger the image will be.

The method of using ground glass is also of value in determining the amount of light necessary and the evenness of its distribution. The camera should not be stopped down at all—that is to say, the opening should be as wide as possible. On a standard instrument this will be stop 7.5.

By the process described we have obtained various pictures of zoological interest. One of a spider leg, for example, taken under low power, gives in clear detail the structure of the tarsus and one joint of the leg. The long spines surrounding the joint and lining the chitinous tarsus may be seen distinctly. The pair of toothed terminal claws and the hairs give an idea how the creature can walk on walls and ceilings with ease.

The simplicity and lack of expense attendant upon taking such pictures as these should recommend itself to the teachers and students of high schools. Series might be made for use in biology, chemistry and physics classes. Not only would the pictures be of great use for demonstration and lecture purposes, but the work of making a group of studies would afford an excellent experience for more advanced students as well.



An advantageous arrangement of the apparatus for amateur photomicrography

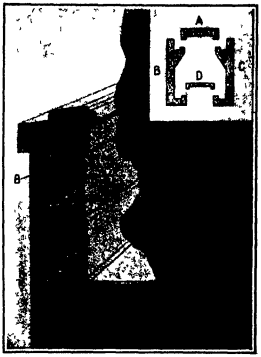
Motor Vehicle Lighting

THE chief of the electrical division of the Bureau of Standards attended one session of the Society of Automotive Engineers at Spring Lake, N. J., on June 21, at which the problem of headlighting for motor vehicles was discussed. The preponderance of opinion was that so far as specifications or laboratory tests of headlight devices was concerned the present status is fairly satisfactory. It is, however, essential that more effective means be found to control the condition of headlights in actual use.

The Negative Hole-Camera

A CURIOUS and interesting reversal of the usual photographic procedure and result is not as familiar as its simplicity would merit. In a dark room a lighted candle is placed upon a table, in front of this is held a cardboard with a small aperture, and in the shadow behind the board a sheet of clear white paper. Under this arrangement, one sees on the paper a reversed image of the flame. If the aperture is fitted up in one side of a box it is possible to get, within, imperfect photographs of the objects outside the box.

So much is well known; indeed, the apparatus has a name—the hole camera. Recently, Prof. Hugo Oschatz, of Reuss, Germany, discovered that there is also a negative hole-camera. A candlelight in a dark room is used, as before, together with a white paper screen for final reception of the image. But, in place of the card with a hole in it, is used a plate of transparent glass with a small piece of paper pasted upon it, at the center, this paper being of size comparable with the hole in the card of the familiar arrangement. With this change, one sees on the white paper the dark image of the flame! The shape of the piece of paper is quite indifferent, just so it be small enough to give an image of the flame rather than of itself. Several pieces of paper may even be used, at different points on the glass, and then one obtains as many images of the flame, but gray rather than black, since all of them receive some direct light from the candle.



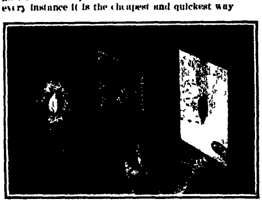
Details of the latest scheme for reducing the cost of concrete construction. The four members A, B, C and D are precast in the factory and assembled on the job, and when concrete is poured into the space between them, a monolithic structure results

Concrete Shells for Concrete Buildings

BUILDING with concrete has become so stereotyped that little thought is given to it by the public or even by those working in it. But the fact is, with forms for an ordinary dwelling house costing something like \$3000 if made under the conventional system, a very considerable amount of inventive effort has been expended with the idea of cheapening this first cost of a concrete residence. Some of the answers which have been proposed to this problem have been such as to cheapen the house as well, which is not what is desired.

One promising line of attack, however, which is usually free from this objection is the building of concrete houses without the use of forms on the spot at all, through the use of pre-cast concrete blocks. The latest development of this idea takes the direction of a concrete tile unit, 5x8x12 inches, weighing eighteen pounds, easily handled and rapidly set. In structure it resembles the hollow clay tile. It is made with a wet mix, on an automatic machine for quantity production, at a minimum cost, and it is claimed that it can compete with all common building materials in its field.

Based upon the concrete tile is another and even more recent type of construction. In this the amount of factory work away from the site is minimized, the pre-casting is limited to the finishes for the inside and outside of the wall, together with caps for top and bottom, as illustrated at A, B, C, D in the accompanying drawing. These are set up rapidly on the job and the space between them poured, making a monolith of the entire assembly. It is claimed that there is nothing that cannot be built in this manner, no matter how small or large, nor how high—whether wall, floor or roof, column, girder or beam, plain or decorated surface, and that in every instance it is the cheapest and quickest way.



The negative hole-camera, in which the opaque spot on the intermediate glass casts an image, not of itself, but of the flame

Colorado's Six-Mile Tunnel Under the Rockies

The Long-Deferred Realization of the Plans for an Air-Line Route from Denver to Salt Lake City

By Theodore Merrill Fisher

IN that epic, the story of the expansion of our borders and the development of the nation, there is no more fascinating chapter than the one dealing with the construction of the great trans-continental railroads. An outstanding figure in that romance is David H Moffat for, from the time of his arrival in the then village of Denver in 1859, he was intimately connected with the growth of the far west, and railroad building was with him a veritable passion In 1867 he gave Colorado its first railroad outlet through a line connecting Denver with the Union Pacific at Cheyenne, Wyoming Later he participated in the completion of the Denver & Rio Grande Railway and many of the local mountain lines that provided transportation facilities for what were then the newly discovered and booming mining camps of Colorado

Coming down the years to 1902, we find him at the age of 65, unlike most business men of his age, tackling his most ambitious enterprise, the connection of Denver and Salt Lake City by the most direct route. As a link in the shortest ocean to ocean line his plans had large national significance their importance being immediately made clear by the bitter and relentless opposition that the Union Pacific and the Santa Fe systems offered because of the serious competition they promised Although these interests were able to cripple his project by cutting him off from eastern financing, he went ahead as best he might with such local capital as he could gather, staking at the same time his own personal fortune on the success of the venture

An important factor in Mr Moffat s scheme—later to be seen as a determining one—was the driving of a long tunnel under the Continental Divide As its cost was measured in terms of millions, the builders of the 'Denver & Salt Lake Railway' were forced to adopt what they deemed but a temporary route over the main range of the Colorado Rockies.

When Mr Moffat died in 1911, a broken man, he had been able to complete but 214 miles of this pet project, scarcely a third of its contemplated mileage The "Moffat Road" became, then, merely a local line, spending three-fourths of its gross income in the almost unending struggle to keep its right-of-way over the "backbone of the continent" clear of snow, with the additional terrific handicap of a 6 per cent maximum grade The scrap heap was the inevitable, final winding-up place for its affairs unless the great tunnel could be put through We need not recount here the long story of the many unavailing attempts to see this accomplished through state aid or ownership However, in May, 1922, the Colorado State Legislature passed an act that will assure the completion of the tunnel This provides for the issuance of $6 720 000 in bonds for its construction, the same being guaranteed by all the private property of what has been designated as the "Moffat Tunnel Improvement District —the northwest section of the state including Denver—which is most immediately concerned with and which will most benefit from the putting through of the whole affair Recently the last legal battle was won with the United States Supreme Court's finding that the basic law was constitutional, and so before this account sees print the Tunnel Commission will have construction contracts ready for bidding if not actually let.

This incredible speed in getting things under way is due to the fact that the determination of the tunnel site will not, as is usually the case, have to be made a matter of months of surveying and preliminary engineering study. Major L. D Blauvelt, who was for many years associated with the "Moffat Road," first as one of the original locating engineers, later as assistant to the chief engineer, and finally as chief engineer, went into the matter very thoroughly for his company, deciding upon three feasible sites and working out approach lines to each After mature consideration of all the engineering and operating factors involved, one of these was selected This judgment is made binding on the Tunnel Commission through the incorporation in the "law" of a provision which definitely names this site as the one that shall be used

The six-mile Moffat bore will threw into the discard a 23-mile stretch of track where the road now climbs the range, with grades as high as six per cent and constant struggle to keep the line open

The tunnel's eastern portal will be about 50 miles from Denver, just beyond Tolland Station—where the road as at present operated begins its long and winding climb to the Corona Summit—and near the headwaters of South Boulder Creek Between portals the length of the tunnel will be 6.04 miles the west entrance being near the headwaters of Frazer River, one of the mountain sources of the Colorado River The east portal is to be at an altitude of 9200 feet above sea level and the west 9100 feet as Corona Summit is 11,660 feet in altitude, the tunnel will reduce the "Moffat Road's" maximum climb into the air by, roughly, 2400 feet and eliminate 23 miles of trackage. Aside from mastering the snow-clearance problem already referred to, the maximum grade on the entire line will be cut to 2 per cent The saving effected by this will be made graphic by contrasting the present haulage of a 40-ton coal train from northwestern Colorado with the eventual situation. Whereas today it takes eight locomotives to get such a train over Corona Summit, eventually one only will be needed for haulage through the tunnel In so doing away with the roads' chief handicap something like a half million dollars will be saved in yearly operating costs, and dependable transportation will, it is estimated, quickly double its business.

What is known as the "pioneer-bore' method of construction will be used by the builders of the Moffat Tunnel This method, which was first devised in putting through the famous Simplon tunnel between Italy and Switzerland, and used for the first time on this continent by the Rogers Pass Tunnel on the line of the Canadian Pacific in British Columbia, requires the drilling of a smaller, auxiliary tunnel parallel to the primary operation. Where under the usual method work on the main bore is restricted to simultaneous drilling from the two ends, the faster progress of the "pioneer bore"—due to its much smaller diameter—permits cross cuts to be run out from it to the line of the main bore and double headings along the latter started from each of them.

Although many engineers are urging that the Moffat Tunnel be made a two-track artery, it will carry but one standard-gage line. The size of the tunnel will be 16 feet width, with a height of 20 feet above the rails, the auxiliary bore will be either 7 by 8 or 8 by 10 feet.

An innovation in engineering practice which the builders of the Rogers Pass Tunnel worked out will be used by those of the Moffat in its excavation. In place of the standard method of a top heading at each "face" and disposal of the "bench" by after blasting and power-shovel mucking, the following will be used The floor of the pioneer bore and the cross cuts from it will be six feet above the level of the main tunnel as completed. Holding to the eventual center line of the latter, "pioneer headings" approximately eight by ten feet will be blasted at each "face" A follow-up drilling gang will then enlarge this preliminary adit to the full size required.

The undertaking is primarily a large-scale mining operation based on three eight hour shifts. As the pioneer bore so materially facilitates the removal of the muck or spoils from the headings, progress becomes, in the main, a matter of drilling speed It is estimated that from two to three years will be required to complete this great bore, at least a year's time being saved in comparison with the old, single-tunnel plan As a single item the pioneer bore would represent a cost of about a million dollars, from which we deduct something like a half million dollars which its use will take off the cost of excavating the main tunnel

The justification of the net cost of the auxiliary bore is found in the use which will be made of it as a water conveyor Anticipating future domestic needs, the city of Denver has filed on water rights near the head of Frazer River across the continental divide A tunnel of some sort would obviously be imperative to make the supply available, and in the usual course of events the city would later be compelled to construct it. With all available sources of supply on the eastern slope now appropriated and many thousand acres of farm lands inadequately supplied with water for irrigation, Denver's new supply, as soon as carrying facilities are ready, will be at once in demand Until the time when domestic use is paramount, the city can derive an annual income of not less than a hundred thousand dollars from this source, consequently, it can well afford to pay a rental, for the use of the pioneer bore as a water conveyor, that will pay for its construction in a short term of years. To secure proper drainage of underground water, the peak of both tunnels will be near the center, the westward grade being .060 and the eastward 020. When the small bore is used for water conveyance purposes, to get the flow over the peak, an intake shaft a hundred and fifty feet deep will be necessary at the western portal.

Because the tunnel will be a public improvement purposed to serve as many uses as may be and free from possibility of monopoly, any railroad that wishes may use it At the moment there is one road besides the Moffat whose interests are intimately connected with the building of the tunnel—the Denver & Rio Grande.

There is no question that, so far as the Moffat line is concerned, the putting through of the big bore will, after long years of frustrated plans and shattered hopes, bring about its completion, thereby opening up for development a vast area in northwestern Colorado and northeastern Utah, and establishing the full significance of the Moffat road in the general scheme of transcontinental transportation.

Charles Doolittle Walcott

By Marcus Benjamin, Ph. D.

DURING the seventy-five years that have elapsed since the organization of the American Association for the Advancement of Science no less than twelve of the most distinguished geologists, beginning with William B Rogers in 1848 and ending with Charles R. Van Hise in 1917, have been chosen to serve as its presidents. This year the Association again turned to a geologist for its leader.

Charles Doolittle Walcott, the youngest son of Charles D. Walcott and Mary Lane Walcott, was born in New York Mills, Oneida County, N Y., on March 31, 1851 He is descended from Captain Jonathan Walcott, who came from Shropshire, England, and died in Salem, Mass., in 1699

As a boy young Walcott developed a taste for natural history, and at the age of thirteen was already making systematic collections of fossils and minerals. His early education was received in the public schools of Utica, and in 1868 he was graduated from the Academy there, after which he spent two years in a hardware store in order to gain a commercial training

It then became necessary for him to decide between a business career and one of research A decision was quickly made and he settled in Trenton Falls, N Y, where he made a collection of the unique limestone fossils from that locality, which later became the property of the Museum of Comparative Zoology, where it had been his intention to study under Louis Agassiz, but which was relinquished on the death of that great naturalist.

In November, 1876, he began his professional career as an assistant to James Hall, then State Geologist of New York, making thereafter extensive researches in New York, Ohio, Indiana and Canada Three years later, in July, 1879, he was appointed field assistant in the U S Geological Survey, continuing in that service until his resignation in 1907, having held in succession the appointments of paleontologist in charge of invertebrate paleontology (1888), geologist in general charge of geology and paleontology (1893) and director (1894), in which last place he remained for thirteen years, reorganizing and developing the Survey on scientific and business principles.

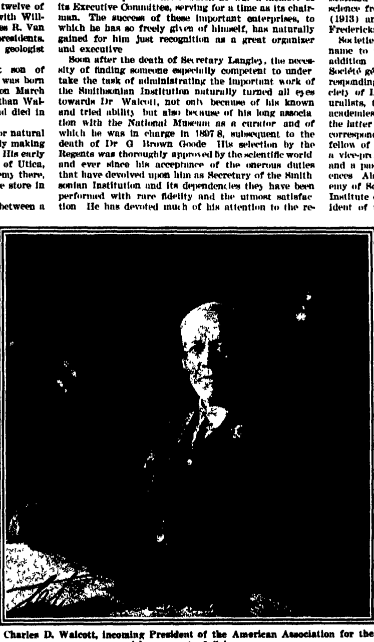
During these years, besides much routine work, he examined and studied the Cambrian formations of the Appalachian belt all the way from Alabama to Quebec, and carried his researches on a more easterly line through New England and New Brunswick to Newfoundland He also began a series of Western studies, which eventually included the most important bodies of Cambrian and pre-Cambrian rocks in Texas, Arizona, California, Idaho, Nevada, Montana, Wyoming and South Dakota Later he turned his attention to a rich fossil locality in the Burgess Shale, near Field, British Columbia, from where he has obtained the finest and largest series of Middle Cambrian fossils ever discovered and the finest invertebrate fossils ever found in any formation. To the description of these fossils, including—besides brachipods and trilobites—merostomes, holothurians, medusae, annelids and malacostracans, he has devoted his leisure during recent years.

He is, therefore, best known as a student of the Lower Paleozoic (Cambrian) and pre-Paleozoic (Algonkian) sedimentary formations and included organic remains. He has himself described his work as follows

"*My own investigations have been mainly in the* Cambrian and pre-Cambrian strata, and have involved new and somewhat startling discoveries that helped to show how very much earlier life was developed on our planet than we had previously supposed. These researches have taken into consideration the records left on all the continents and many of the great islands. Field work, with compass, hammer and chisel, has been the rule, followed by laboratory and critical comparison of many thousands of specimens of fossil genera and species of ancient marine life, and often study of microscopic sections of rocks and fossils, in the hope of finding evidence of the presence of minute and active bacterial and simple algal workers, such as exist in modern seas and lakes, which by their united efforts form great masses of the recent sea and lake deposits."

During the years 1902-7 Dr Walcott had charge of the organization and conduct of the U S. Reclamation Service, and also he had much to do with the development of the movement for the preservation of forests. It should also be mentioned that he was secretary of the Carnegie Institution of Washington during 1902-5—its formative period—after which he was a member of its Executive Committee, serving for a time as its chairman. The success of these important enterprises, to which he has so freely given of himself, has naturally gained for him just recognition as a great organizer and executive

Soon after the death of Secretary Langley, the necessity of finding someone especially competent to undertake the task of administrating the important work of the Smithsonian Institution naturally turned all eyes towards Dr Walcott, not only because of his known and tried ability but also because of his long association with the National Museum as a curator and of which he was in charge in 1897 8, subsequent to the death of Dr G Brown Goode His selection by the Regents was thoroughly approved by the scientific world and ever since his acceptance of the onerous duties that have devolved upon him as Secretary of the Smithsonian Institution and its dependencies they have been performed with rare fidelity and the utmost satisfaction He has devoted much of his attention to the research explorations of the Institution, and among these the African Expedition of 1909-10 under Colonel Theodore Roosevelt is the one most widely known That he may live long and continue to contribute his valuable energies to the administration of science is the abundant testimony of his colleagues in Washington



Charles D. Walcott, incoming President of the American Association for the Advancement of Science

Dr Walcott's activities in other directions are many, but of two specific mention must be made During the period of the World War he became chairman of the National Advisory Committee for Aeronautics, and he was chairman of the military section of the National Research Council

The results of his many investigations have been given to the world chiefly through the publications of the U S Geological Survey or the Proceedings of the U S National Museum, and more recently, the Smithsonian Miscellaneous Collections, and in addition to these sources there have been frequent papers in the *American Journal of Science* and similar publications, both at home and abroad His entire bibliography is therefore quite extensive and includes more than one hundred titles of major importance

His scientific attainments have received deserved recognition by the conferment of the Hayden medal in 1905 of the Academy of Natural Sciences in Philadelphia, the Bigsby medal in 1895 and the Wollaston medal in 1918 of the Geological Society of London, and the Gaudry medal in 1917 of the Société géologique de France Academic appreciation of his distinction is shown by the following honorary doctorates in law from Hamilton (1897), Chicago (1901), Johns Hopkins (1902), Pennsylvania (1903), Yale (1910), St. Andrews, Scotland (1911), and Pittsburgh (1912), doctorates in science from Cambridge, England (1909) and Harvard (1913) and a doctorate in philosophy from the Royal Fredericks University of Christiania in 1911

Societies and academies have been proud to add his name to their lists of distinguished members and in addition to the London Geological Society and the Société géologique de France, he holds honorary or corresponding relationships in the Royal Geographical Society of London, the Moscow Imperial Society of Naturalists, the Christiania Scientific Society and in the academies in Bologna Rome Stockholm and Paris, in the latter of which he is one of the very few American corresponding members. At home he is an associate fellow of the American Academy of Arts and Sciences, a vice-president of the American Philosophical Society and a past president of the National Academy of Sciences Also he was president of the Washington Academy of Sciences (1899-1910) and of the Archaeological Institute of America (1915-17) He has served as president of the Cosmos Club (1898)

His connection with the American Association for the Advancement of Science began with his election to membership at the Buffalo meeting in 1876, and six years later he was advanced to the grade of fellow. In 1893 he presided over the section on Geology and Geography and delivered an address on "Geologic Time as Indicated by the Sedimentary Rocks of North America At the meeting held in Boston last Winter he was chosen president of the Association thus confirming his standing as the foremost geologist of America, a fact further certified to by the statement made when he was presented with the Wollaston medal that "his personal researches have excited interest and admiration wherever geology is cultivated"

Physiological Effects of High Temperatures

VENTILATION is of little use in reducing discomfort from high temperatures in humid air after the temperature has risen to approximately that of the human body, according to a report of recent experiments made by the United States Bureau of Mines on the physiological effect of high temperatures with and without air movement In temperatures up to 95 degrees the movement of air caused much relief At 100 degrees the symptoms were fully as severe with moving air as with still

The experiments were carried out by Dr R R Sayers, chief surgeon of the Bureau of Mines, and D Harrington, supervising mining engineer The subjects were experienced mine laborers The work was carried on in deep and hot metal mines.

The principal effects of exposure to hot, humid and stagnant air were a rise in the body temperature of two or three degrees, a fall in blood pressure, perspiration so profuse that the subjects shoes were partly filled with sweat and sensations of giddiness and weakness. These symptoms were all very pronounced at 95 degrees in stagnant air If the air were in moderate motion little discomfort was felt

This was not the case, however at temperatures of 98 degrees and more Symptoms in still air which were more trying than at the lower temperatures, were not much relieved by a current of air, while at 100 degrees they were so unbearable that even when the air was moving the subjects were not able to stand a full hour's exposure to the conditions.

More recently a more thorough study of the effect of high temperature has been made possible through the use of a specially designed room where any desired conditions of temperature humidity and air movement which are likely to be met may be maintained

From this a system of "comfort lines is being worked out, a graphical representation of the combinations of temperature and moisture at which equal comfort is experienced It has been shown that while humidity has a marked influence the temperature taken by the ordinary dry bulb thermometer is of great importance The discomfort experienced is shown to be due more to the increase in the pulse rate than to any other cause, according to findings of Dr Sayers of the Bureau of Mines, and D Harrington, supervising mining engineer

Left: Dust from a mine-ventilating shaft, magnified 2000 diameters. *Center*: Section of a human lung showing deposits of coal-dust and soot in cell tissues, with magnification of 200. *Right*: Dust that drifted with the wind across the North Sea to England; magnification, 1000 diameters

A few rather surprising samples of the air we breathe, showing its dust content

The Air We Breathe

New Types of Apparatus for Measuring the Suspended Dust in the Atmosphere

By John B C. Kershaw

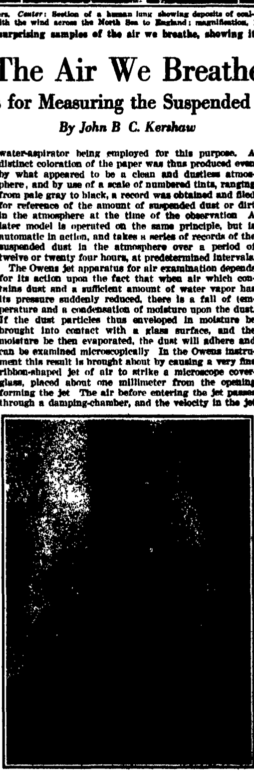
FEW of us are unfamiliar with the old experiment of allowing a beam of sunlight or of some strong artificial light to pass through a small opening in a shutter into a darkened chamber or room, and with the accompanying revelation of the countless millions of dust particles which float suspended, but in perpetual movement, in the air It is not so generally known however, that the study of this suspended matter of the atmosphere is now being placed upon a more scientific basis, and that instruments have been devised and are now in use which permit the number of these suspended dust particles to be accurately recorded, and their character to be examined

It has, of course, been known for many years that the finer particles of soot and ash discharged from high factory chimneys could be carried by wind and air currents for many miles over the surrounding countryside but the distance at which vegetation ceased to be destroyed or checked was supposed to mark the extent of this transport of injurious dust and vapor in the neighborhood of industrial towns and districts. Some experiments carried out last year, however, by Dr Owens of the British Meteorological Office seem to indicate that the finer suspended dust particles of air can be carried to much greater distances than has hitherto been supposed, and that under favoring circumstances and atmospheric conditions, they may even be transported across hundreds of miles of sea, and thus pass from one country to another The dust particles shown in our first illustration, which Owens found in the air on the East Norfolk coast, in his opinion were not of local origin, but had traveled across the North Sea on easterly air currents and had come probably from the smoke discharged by factory chimneys of Belgium or Germany

It is well, therefore, to take cognizance of these new methods of dust observation and of their results. If the comparatively harmless fine ash and dust particles from industrial centers can be carried by air currents for such great distances over intervening seas and oceans, disease germs and other deleterious dust particles may be disseminated in the same manner, and the possibilities of infection or attack by air will have to be studied from quite a new standpoint Some of the mysterious outbreaks of infectious disease in the past may be due to air borne germs, and not to infection by contact.

The instruments which have been devised by Dr Owens for the collection and examination of the suspended matter in the air are highly ingenious. In the case of his air-sampler, the difficulty caused by the relative smallness of the amount of suspended impurity in the air in comparison with the volume of the air which contained it was overcome by reducing the area of the filter-paper used to very small dimensions—to a diameter of one millimeter, in fact The paper was clamped tightly between the two brass parts of the apparatus by turning a milled-head screw and 2000 cubic centimeters of air was then drawn through the very minute area of filter-paper exposed between the two openings of the brass headpiece of the apparatus, a water-aspirator being employed for this purpose. A distinct coloration of the paper was thus produced even by what appeared to be a clean and dustless atmosphere, and by use of a scale of numbered tints, ranging from pale gray to black, a record was obtained and filed for reference of the amount of suspended dust or dirt in the atmosphere at the time of the observation A later model is operated on the same principle, but is automatic in action, and takes a series of records of the suspended dust in the atmosphere over a period of twelve or twenty four hours, at predetermined intervals.

The Owens jet apparatus for air examination depends for its action upon the fact that when air which contains dust and a sufficient amount of water vapor has its pressure suddenly reduced, there is a fall of temperature and a condensation of moisture upon the dust. If the dust particles thus enveloped in moisture be brought into contact with a glass surface, and the moisture be then evaporated, the dust will adhere and can be examined microscopically In the Owens instrument this result is brought about by causing a very fine ribbon-shaped jet of air to strike a microscope cover-glass, placed about one millimeter from the opening forming the jet The air before entering the jet passes through a damping-chamber, and the velocity in the jet is such that the fall of pressure results in bringing about a condensation of moisture on the dust at the moment of striking the cover-glass. The air is then deflected, and as the velocity falls off, the pressure and temperature rise, the water is evaporated, and the dust which it has abstracted from the air is left behind as a deposit on the glass.



The Owens automatic air filter, with attachment raised for charge of recording disk

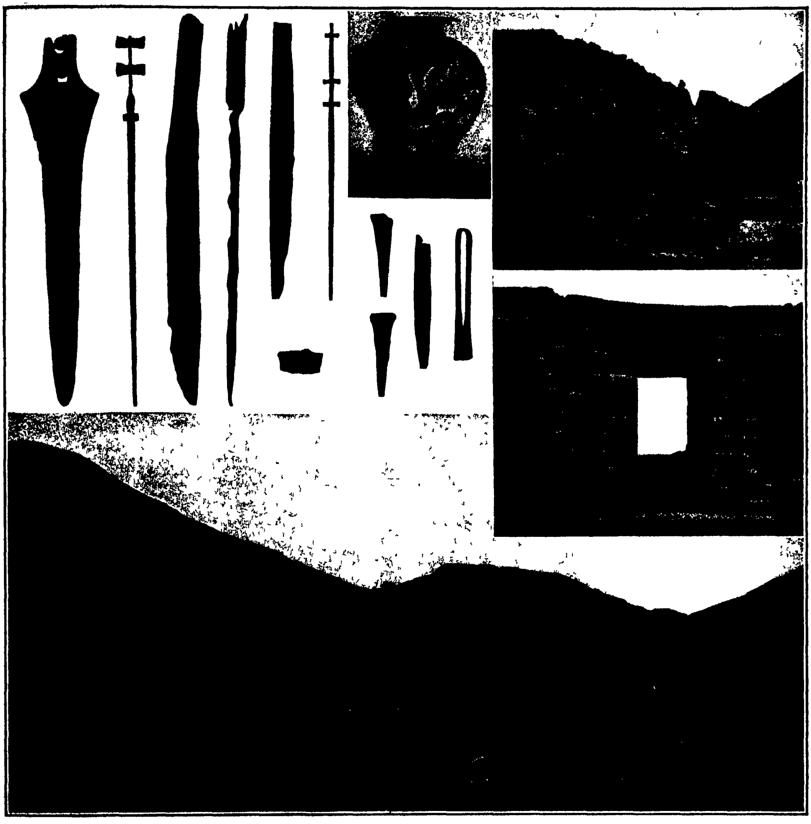
The apparatus is so arranged that the record consists of a linear deposit of dust, and a count of the number of particles may be made by the aid of the eye-piece micrometer, a strip being counted completely across the record at several places and an average taken, to be multiplied by a factor depending upon the length of the strip and the spacing of the sample countings.

It appears probable from the tests already made by Owens, and detailed in his original paper contributed to the Royal Society in November, 1921, that the presence of suspended dust in the air is one of the chief governing factors of visibility on occasions when there is no water fog to obliterate vision at short distances. On several occasions when the visibility in country districts was bad, and a distinct gray or bluish haze was seen against distant objects, the tests revealed the presence of abnormally large numbers of dust particles in the air

Another application of the apparatus is in the examination of expired air, with a view to ascertaining whether the suspended impurities in the air breathed are retained or expired. The experiments made so far indicate that the tidal air expired contains a large proportion of the suspended matter which was inspired, while the "reserve" air from the deeper parts of the lungs, while containing very much less than the tidal air, still contains also some of the suspended matter breathed in. An important result obtained was that the quantity of dust in the deep parts of the lungs depended chiefly upon the nature of the breathing; that is, "deep breathing" from any cause carried dust into the deeper parts, and even the last part of reserve air under such conditions was found to be laden with dust.

Other applications of the Owens jet apparatus are for the examination of fumes from smelter chimneys and of mine dust, and for the determination of the vertical distribution of the suspended matter in air The whole apparatus is small and light, and a record can be taken with it in a few seconds, at any place or in any position. The microscope slip with its deposited dust can then be labeled and numbered and the examination of the deposit carried out at leisure under more comfortable conditions in the laboratory.

When necessary, reagents may be applied in order to identify the nature and character of the deposited dust particles, working in accordance with microchemical methods of analysis, and in this way much valuable information may be obtained as to the best methods of treating and removing the dust or fume from the air which contains it. The presence of harmful bacteria and disease germs in abnormal numbers may also be detected by the jet apparatus, and the necessary measures or precautions taken for defence against them.



AT Mycenae, the city of Agamemnon, new pages of history are being uncovered according to Mr A. J. B. Wace, Director of the British School of Archaeology at Athens, which has been making new excavations at this classical site. In the private apartments of the palace a tank-bath lined with red stucco was discovered. Here were found the bronze daggers and the vase which we picture. Extraordinary domed tombs were found which show an elaborate system of counter-weighting and wedging the stones that inclined inward to make the dome. Even at this early date Mycenaean engineers and architects had both imagination for drawing plans and knowledge for making calculations and construction. The palace on the summit of the Citadel now appears to have been a large building with several stories. The palace was built about 1400 B. C. Other work included the excavation of the fort or signal station on the summit of Mount Hagios Elias (2500 feet) whence the news of the fall of Troy might have been flashed by fire-signal to Mycenae below. An examination of the tombs show that the later members of the family seemed to have had no scruples in sweeping aside, or even throwing outside the bones and other relics of the earlier interments and appropriating valuables.

Our photographs show the ancient Greek weapons recently found in Mycenaean tombs, as well as a vase or jar with a highly realistic octopus design. The topmost right hand photograph shows what was once the approach to Agamemnon's throne room—the great south stairway of the Palace of Mycenae. The drawing below it shows the building technique of the 15th century B. C., in this case the door of the "Lion Tomb." The large view shows the Citadel on the mountain at the left. We are indebted to *The Illustrated London News* for the photographs and data.

MYCENAE, THE CITY OF AGAMEMNON, AS BROUGHT TO LIGHT BY THE ARCHAEOLOGISTS

The Heavens in December, 1923

Mathematical Theory and Observed Fact Regarding the Nebulae

By Professor Henry Norris Russell, Ph.D.

WE spoke last month of the spiral nebulae—their strange forms, stranger motions, and enormous size. No one could follow such a story without the instinctive question, 'But what are these nebulae? Have we any idea of their real nature?'

Though this bold query cannot be answered with assurance today, we are by no means in utter uncertainty. The astronomical world possesses a theory of their nature which matches the principal facts so well that, though "not proven," it commands the sympathy and indeed the belief of the most competent authorities.

Perhaps the most remarkable feature of this theory is its origin. For once, we come on the rare case of a hypothesis of great practical attractiveness which originated, not from a study of the bodies to be explained, but from purely theoretical considerations developed in the investigation of a highly generalized problem.

We refer, of course, to the remarkable work of Jeans—one of the most distinguished of English mathematicians, who has hardly a rival in that difficult field where mathematics, physics, astronomy and geology may dispute the sovereignty. The abstract problem which he was discussing was the old and intricate one of the behavior of a mass of rotating fluid. Such a mass, if isolated in space, would settle down, under its own gravitation, into some definite "figure of equilibrium." If the mass was not rotating at all this figure would obviously be a sphere. If the fluid was incompressible, its density would be the same everywhere; if compressible, it would be denser—probably much denser—at the center, but still spherical.

Let us now suppose the mass to be in slow rotation. The problem is more complex: we have a centrifugal force, acting outward in the plane of the equator, combining with gravity. It is easy to see that if small, this force will make the body bulge out at the equator and flatten down at the poles. But the amount of the bulging is not easy to compute, for the very change of shape alters the gravitational attraction at the surface. For slow rotation, however, the problem was solved a century ago—at least, for the homogeneous mass. The cross-section, along a meridian, becomes an ellipse, while the equator is still a circle. The earth and Jupiter, though denser toward their center, illustrate this case.

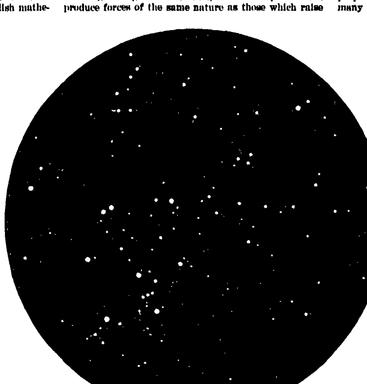
Figures of Equilibrium

But what if the rotation grows more rapid—as must actually happen if the mass cools down and contracts? In this event, a homogeneous mass will become more and more flattened at the poles, with its equator circular, until it reaches a certain limiting shape, and then a strange thing happens. The equator itself becomes elliptical, and the mass resembles in form a cake of toilet soap, rotating about its shorter axis. With increasing rotation, the long diameter of the equator becomes twice, and even three times, the other, so that the figure is almost cigar-shaped. Then again a change occurs. One end of the "cigar" tends to elongate and the other to become short and thick. At this point the mathematical analysis becomes appallingly complicated, and it was not until Jeans attacked the problem (a little matter of a year or two of calculation) that it was cleared up.

Beyond this point, he finds, there can be no real equilibrium at all. One end of the "cigar" lengthens rapidly, the other fattens, and a neck forms between them. Doubtless this neck soon breaks, and we get two independent masses rotating about one another, and almost in contact—after which the friction of the tides which they raise on one another will drive them slowly apart, as Darwin showed years ago.

Practically every stage beyond the point of actual separation is exhibited to us among the eclipsing variable stars. But these stars are formed of compressible gas, and must be condensed toward their centers. How will this affect things?

This problem is even a more difficult one than the other, but Jeans has successfully attacked it. If the central condensation is small or moderate, the course of events follows essentially the line already sketched. But if the outer parts are of low density and the central condensation great, the whole story changes. For slow rotation the shape is much as before, but as it spins faster, the sharply curved part of the surface becomes more and more localized at the equator, and it comes to resemble a double-convex lens (or a reading-glass without the frame). Finally the equatorial edge, at first rounded, becomes quite sharp. At this stage the centrifugal force at the equator just balances gravity, and for any further rotation something must break loose. For a mass quite isolated in space, the surface portions would begin to spread out in the plane of the equator into a wide, flat sheet. But no actual body even in interstellar space, is quite isolated. The attraction of the neighboring stars at least, must act upon it and produce forces of the same nature as those which raise the tides in our oceans. The outer edges of the lens-shaped mass, in this critical state, will be very sensitive to the smallest forces, and the outcome is that the outflow of matter, thrown off by the rapid rotation, will take place at two opposite points on the equator, the "high-tide regions," so that it will escape, not in a sheet, but in two oppositely directed streams. If the quantity of outflowing material is small, it will dissipate into space; if it is large, the mutual attraction of the particles will keep the stream from spreading out laterally, and it will form a long filament. There is, however, a strong tendency for such a filament to break up longitudinally into separate bits, just as a narrow jet of water (under quite different forces) breaks up into separate drops. So our rotating mass, if huge enough, will surround itself with a swarm of small condensations arranged in streams along the bulk of the filaments from which they have been formed, and issuing from two opposite points on the periphery of the central mass.



At 11 o'clock: Dec. 7
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.
At 9½ o'clock: December 30
At 9 o'clock: Jan 7
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan 22

NIGHT SKY: DECEMBER AND JANUARY

Mathematics and the Nebulae

All this came as a definite, but in a sense unexpected, result of Jeans' mathematical reasoning. The resemblance of the resulting picture to that actually presented by the spiral nebulae is striking to a degree. Indeed, almost every form predicted by the theory, from the globular mass, through the sharp-edged one, to the nucleus surrounded by innumerable condensations, can be found repeatedly on nebular photographs. If such a success was not enough, it must be added that Jeans, assuming (as seems reasonable) that the condensations in the spiral arms of the nebulae are as big (or, rather, as massive) as stars, finds it possible, from general considerations, to work out roughly the size of the nebula and the rate at which it is throwing off matter from its rim. He is thus led to estimate that the distances of the great spirals in Andromeda and Ursa Major are of the order of 3000 and 5000 light years, which is consonant with what other information we can get upon the matter, while the masses of the nuclei must be enormous—in the Andromeda nebula, perhaps a billion times that of the sun.

No other theory of spiral nebulae has so far been proposed which is anything like as satisfactory. But many difficulties remain. One is found in the fact, clearly proved by van Maanen, that the motions in the outer parts of the arms increase as if athwartwise force was acting upon the particles. Another is that the spectra of the central portions are just what might be expected from a cluster of stars generally similar to the sun. Yet at the probable distances of these nebulae, the individual stars should be shown on our photographs (unless they were all much fainter, intrinsically, than the sun). Twenty years hence, or even ten, there may be other chapters to add to our story, equal in interest to any that have so far been read.

The Heavens

The winter skies are now in their full glory. Orion blazes high in the southeast, with Taurus above and Sirius below. Procyon, Castor, Pollux and Regulus are all in the east—the last rising. The Great Bear ascends in the northeast, the Dragon swings low in the north, and Cassiopeia and Cepheus are sinking in the northwest, above Cygnus, which is setting. Auriga and Perseus are overhead. Andromeda, Aries and Perseus in the west. The south west, with the sparse stars of Eridanus and Cetus, is the only dull part of the sky.

The Planets

Mercury is an evening star all the month, but is so far south that he will be hard to see. The best time is about the 27th, when he is farthest from the sun, but even then he sets at 6 P. M.

Venus is also an evening star, but is further from the sun than Mercury and much easier to see. By the end of the month she remains in sight until 6 45, and should be easy to see just about dark.

Mars is a morning star in Virgo, rising at 3.30 A. M. in the middle of the month. On the first he is in conjunction with Saturn. The two planets are 1¼° apart and should present a pretty spectacle.

Jupiter, too, is a morning star, but much nearer the sun, and does not rise until nearly 6 A. M.

Uranus is in Aquarius, and is in quadrature east of the sun on the 6th, so that he can be observed all the evening. Neptune is in Leo, and rises about 9 P. M. in the middle of the month.

The moon is in her last quarter at 5 A. M. on the 1st, new at 8 P. M. on the 7th, in her first quarter at 10 P. M. on the 14th, full at 3 A. M. on the 23rd, and in her last quarter again at 4 P. M. on the 30th. She is nearest the earth on the 6th, and farthest away on the 19th. During the month she passes near Saturn and Mars on the 4th, Jupiter on the 6th, Mercury on the 8th, Venus on the 9th, Uranus on the 14th, and Neptune again on the 26th.

At 3 54 P. M. on December 22nd the sun reaches his greatest southern declination, and enters the sign (though not the constellation) of Capricorn—and, in almanac language, "winter commences."

Princeton, N. J.
Oct. 1, 1923.

Metering Water by the Wholesale

VAST quantities of water are used by modern large hydroelectric power plants and the problem of metering this water, wherever this is required, is not such a simple matter as would at first thought appear. Several methods have been used but none has been satisfactorily accurate when the work involves such large amounts of water. In factories, water is often weighed in tanks, made to tip automatically when filled and spill the water into other receptacles. Nothing like this could possibly be used in such large power installations as, for instance, a certain one which uses 8500 cubic feet of water per second.

A new method of measuring water has been worked out by Professor C. M. Allen, of Worcester Polytechnic Institute and in practice has given remarkably accurate results. Common salt or sodium chloride increases the electric conductivity of water and this increase is in direct proportion to the amount of salt in solution. Brine is introduced into the pipelines at a considerable distance upstream and automatic timing devices record the changing conductivity of the brine as it passes given points at which electrodes are inserted on opposite sides of the line. By dividing the volume of the pipe between the two points by the rate of passage, the rate of flow is arrived at. When tested against the weir and Venturi meter the new method is found to be very accurate. It proves superior to the method of measuring stream flow by the submerged float method and it is vastly better than the method which requires expensive tanks.

Pulling Down a Church Steeple With a Motor Winch

A STRIKING example of the all-around usefulness of motor truck winches was brought to light the other day in Jamestown, N. Y. The Presbyterian Church, one of the city's old landmarks, was being wrecked to make way for a new hotel. Higgins & Haupin, contractors for the job, swung a heavy cable from the top of the steeple to a motor truck winch mounted on a six ton motor truck. On the first attempt to pull the steeple over the cable snapped. A new cable was attached. The winch operated by the truck engine wound slowly around. After straining and cracking for about three minutes, the steeple fell with a crash that could be heard for several blocks.

Small capstan winches, operated on the motor's idling power, are coming into widespread use as regular equipment on motor trucks. They are used for a surprising number of jobs from loading trucks to hauling heavy boilers, from hoisting safes to wrecking buildings.

Chewing Up the Soil for Better Crops

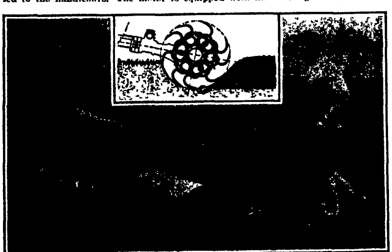
ON the American market today there are several different manufactures of garden tractors and now from England comes the description of one which differs radically from the American variety in that the soil is worked by a revolving member called a miller, instead of by the common toothed cultivating attachment. The function of the miller is to chew up the soil mixing, lightening and incorporating it thoroughly with the fertilizer that has already been spread over it.

The rototiller is driven by a two-cycle, 8 to 10 horsepower engine. Lubrication is provided by mixing the oil with the gasoline in the tank, as in small engines used on motorboats. The engine is cooled by means of a radiator of two gallons capacity and by a fan running on ball-bearings. Ignition is by high tension magneto. As in the case of the garden tractor the controls are led to the handlebars. The motor is equipped with an air-cleaner working on the labyrinth principle.

The bull wheel shaft is driven by a steel worm working on a phosphor-bronze worm wheel. The gears are of hardened nickel steel and run in an oil bath. Two speeds are provided for, the high speed corresponding to over 1½ miles per hour and the low speed being ¾ mile per hour with engine running at 1400 r.p.m. The bull wheels are 18 inches in diameter and the extreme width over all, without the regular 30-inch miller, is 24 inches.

The miller is driven by a bevel pinion and crown wheel enclosed in an extension of the gear box which forms part of the body and these run in oil. The miller drive is independent of that of the bull wheels, permitting the rototiller to be moved about without operating the rototilling member or miller. The latter revolves at 150 r.p.m. and carries twenty coil springs on whose extremities are fitted twenty semi-circular hooks of steel. These are the tools which attack the soil. The total weight of the machine is 650 pounds and its height is 37 inches.

One of the most satisfactory qualities of this cultivating device is its low speed. In order to do good work a garden tractor should not be geared so as to run as fast as three miles per hour—a speed at which the control of the tools is erratic, especially in rough or lumpy soil, therefore the low speed of the rototiller is an advantage.

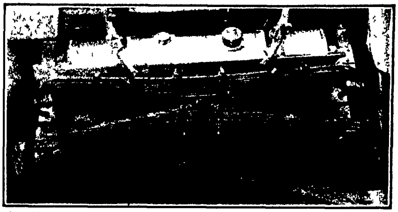


Rototiller in operation, with a diagram showing how its semi-circular hooks tear up the soil and leave it in a pulverized, aerated condition for planting

This church steeple is being pulled down by means of a motor-truck winch and heavy cable

Talc

TALC is by no means used only for the manufacture of talcum powder. Much of it is unsuitable for this purpose and is used in paint as a body material for filling paper, for use in the manufacture of rubber, and roofing. Much of the talc used comes from northern New York, Vermont and Virginia. The talc rock of New York is mined and brought to the talc mill where it is ground in ball mills until it will pass a 325-mesh sieve.



An odd spring suspension which takes the place of the usual shackle arrangement and which is said to make for greater riding comfort

Taking the Roughness Out of Ruts

STILL *another device for taking the roughness out of* ruts now makes its appearance. This time it is in the form of a new type of automobile spring suspension, worked out by L. H. Timmons of Des Moines, Ia.

Constructed on the theory that unsprung weight is the enemy to riding comfort, Timmons, through the medium of rolling contact bearings and relief springs, has evolved a type of spring suspension which is shown in the accompanying illustration. The rear auxiliary relief spring here shown is composed of double transverse straight laminated springs secured at their centers with a roller bearing oscillating joint between. Each end of the upper spring is connected to the side frame by means of a roller bearing device. The lower springs are held in contact with the side springs by a rubber padded stirrup with a ball bearing between the springs making a frictionless connection and allowing a greater range of spring or axle movement than with the usual construction.

The front relief spring is a quarter elliptic laminated spring attached to the rear end of the present semi-elliptic side spring by a connection encasing a barrel-shaped roller bearing, the thick end being rigidly attached to the frame. The effect of this combination, according to the inventor, is the same as that of a long straight spring, since the arrangement allows double the ordinary range of spring movement. In this manner noiseless spring connections take the place of spring shackles which are *subjected to heavy loads.* Snubbers from axle to frame prevent excessive changes from normal positions.

Asphaltic Types of Pavement

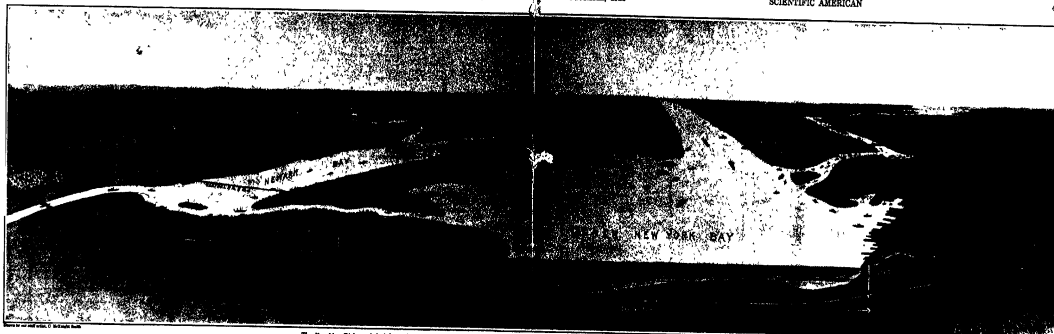
IN 200 leading cities of the United States there is enough pavement to cover an eighteen foot street that would twice encircle the globe. This mileage by far exceeds that of every other country of the world. Of this total amount of pavement 78 per cent is of the type higher than waterbound macadam, including about 22 per cent of brick, 11 per cent of stone block, 3 per cent of wood block, about 6 per cent of portland cement concrete, 2.5 per cent of tar macadam and 54 per cent of asphaltic types.

The overwhelming predominance of the asphaltic types of pavement indicates the determination of modern cities to eliminate dust, noise, shock and interruption to traffic in street construction as far as possible.

The vast network of underground structures in American cities, including wires, pipes and conduits, make it necessary to open the pavement at frequent intervals to obtain access to these underground services. The engineer must, therefore, provide a pavement which can be cut through without great trouble and expense, which can be readily repaired and which, after it has been repaired, blends with the old pavement.

For fast moving traffic the modern city pavement must be smooth not only to permit the rapid and comfortable movement of vehicles but to conserve motor fuel and tires. Only a slight saving in the operating cost per motor vehicle by reason of the smooth pavement reaches an aggregate, when the vast number of motor cars is considered, to justify a *considerable* outlay to obtain durability and smoothness.

Impact or the pounding of heavy motor truck wheels, has attracted the anxious attention of city highway engineers to an increasing degree during the past ten years. A truck wheel with a drop of only one inch when in motion delivers a blow equivalent to at least six times the dead weight. City engineers therefore attach increasing importance to the flexibility and resiliency of city pavements so as to take up the shock of impact.



Drawn by our staff artist, C. McKnight Smith

The Brooklyn-Richmond freight and passenger tunnel, which is to pass under the Narrows, showing its connections with trunkline railroads in New Jersey

The World's Largest Subaqueous Tunnel

Building a $60,000,000 Freight and Passenger Tunnel Beneath the Narrows, New York

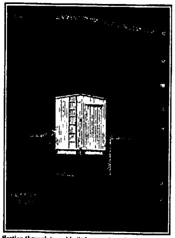
IN the presence of the Mayor of New York and other city officials, ground was recently broken for the construction of the shaft at the Brooklyn end of a $60,000,000 freight and passenger tunnel which is to be built under the Narrows to Richmond Staten Island The location of this shaft is at Shore Road and Bay Ridge Avenue

Thus was inaugurated the construction of what will be one of the largest subaqueous railroad tunnels in existence, and if we include the land portion of the tunnel, the whole structure takes rank as among the largest railroad tunnels in existence In 1921, the New York State Legislature directed the Board of Estimate of New York City to begin within two years the construction of this tunnel with a view "to maintaining the supremacy of the Port of New York" Immediate study was made by a corps of engineers of the project and the actual construction work has been started within the alloted time originally set

The route chosen for the tunnel contemplates a railroad of first-class construction from Bay Ridge, where it will connect with the Long Island Railroad and also with the Fourth Avenue Brooklyn Rapid Transit subway, to Arlington, on Staten Island, where it will join up with the Baltimore & Ohio Railroad, the total length of the railroad being ten miles. We have prepared a bird's-eye view, taken from a position south of the Narrows and looking north across upper New York Bay, and including the greater part of the metropolitan district.

The foreground of the picture presents a vertical section taken through the site of the proposed tunnel Its eastern entrance lies about 4000 feet back from the shoreline of the Narrows, then it falls on an even grade until it reaches a point well below the bottom of the Narrows. On the Staten Island side the tunnel passes below the range of hills which runs generally north and south through Staten Island, and then emerges and continues as a surface railroad to a junction with the Baltimore & Ohio Railroad, crossing the Kill Van Kull to New Jersey by means of a bridge with suitable openings for steamships and other traffic

The distance between the shafts on each side of the Narrows will be 10,500 feet, the greater part of which will be at level grade The land tunnel will total about 18,500 feet and there will be 22,000 feet of surface railroad the total length of the line being as we have stated, about ten miles The estimated total cost of the line, as now planned, is about $60 000 000



Section through tunnel built by trench method It consists of a plate steel tube stiffened by steel diaphragms, the whole being encased in concrete

It is the expectation of the projectors that this important work will ultimately form part of a great belt-line system, which will start from the banks of the Hudson River in the northerly limits of the metropolitan area, and swing around the westerly outskirts of the district at a distance, more or less, of twenty miles from the Jersey City terminals of the transcontinental railroads, until it intersects the Baltimore & Ohio Railroad near Staten Island Its connection, at its easterly end, with the Long Island Railroad will complete the circuit, and thus provide the metropolitan district with an exterior belt line, intersecting all the railroad systems which enter New York, and making it possible to transfer freight at the various points of intersection and carry it directly to the steamship, factory and warehouse to which it is consigned, without any breaking of bulk or any intermediate handling One important advantage of such a belt line would be to get rid of a great part of the present cumbersome and costly method of transporting freight by means of steam lighters and barges. In view of the fact that over one-half of the foreign trade of the United States passes through the Port of New York, and that after a carload of freight from the interior has reached Jersey City, it costs something like two and one-half dollars per car to get it to the consumer, it will be understood that there is urgent need for making a drastic change in our terminal facilities at this city and port. As a matter of fact, it costs as much to transfer merchandise from the Jersey City Terminal to the consignee as it does to haul it from five hundred to seven hundred miles overland.

The importance of the new tunnel, however, is further enhanced by the fact that it will put Staten Island in direct rapid transit communication with Brooklyn, Manhattan and New Jersey Of all the great boroughs into which New York is divided, the Borough of Richmond has been the most neglected as regards its transportation facilities. The only means of access is by ferry, and this service is not only slow, but is subject to serious delay during the prevalence of fog and of severe freezing weather in the winter While the various suburban districts of New York have been quickly built up as the result of the rapid extension of our excellent system of subway and elevated roads, Staten Island is as yet an undeveloped region, and this in spite of the fact that its nearness to the sea and its diversified scenery render it ideal for suburban residences.

As against a belt line built well back from Jersey City and running through farm lands where the cost of the necessary right of way would be moderate, the Port Authority favors the construction of a belt line within a mile or so of the Jersey City water front. This would involve condemnation of expensive property and would add to the railroad congestion which already exists to no little extent in that territory, and although such a belt line would be much shorter, it would not give such comprehensive service as the one we have referred to above. We believe that the Port Authority should think less in terms of the present and more in terms of the future The outer belt line, which may seem remote to the present generation, will not be remote in the next, so rapid is the growth of our amazing city, a growth, by the way, which the construction of this tunnel and of an adequate belt line will very greatly promote

As to the structural features of the tunnel, there is some division of opinion There are those engineers who believe that there is no system of construction superior to the use of the shield and the building of a cast iron tube lined with concrete This system has the advantage that it has been thoroughly tried out, and that all the existing tunnels beneath the North River and the East River are of this type Tubes driven by the use of the shield can go where they wish. They are very strong and stiff, and the experience of many years has shown, once they are built, they are not subject to any displacement, or to any heavy bending stresses that would tend to produce fractures.

On the other hand, there are those who advocate building the tunnel by what may be called the "open cut" or trench method In this type, of which we show a cross section, the tunnel is built without the use of any shield The first operation is to dredge a trench at the bottom of the river or channel in which the tunnel is to be built, wide enough to take the two tubes The next step is to lower the steel structures into the trench, in lengths of about two-hundred-and-fifty feet. This steelwork consists of two circular tubes built of three-eighth inch shell plating, stiffened and carried at every twelve feet by steel diaphragms of three-eighth-inch plate Our cross section of one of the tunnel openings shows that this diaphragm is rectangular in outline, with stiffening angles extending from the outside of the tube plate to the outer edges of the diaphragm It should be mentioned that piling is driven in the bottom of the trench to receive the ends of the tube sections after the various lengths of the steelwork have been laid and connected up. The whole mass is embedded in concrete deposited under water from concrete-mixing barges at the surface When this has been done, the structure it will be seen, consists of a monolithic concrete mass, with two parallel tubes passing through its center The integrity of the tubes is further protected by lining them inside with concrete, as shown in our illustration. Bids may be put in for either the shield or the trench system of construction.

A Permanent $500,000 Fund for Scientific Research

THE British Royal Society is the recipient of a permanent fund amounting to one hundred thousand pounds to be used as the Society sees fit in the furtherance of scientific research. Sir Alfred Yarrow, the donor of the fund believes that the future prosperity of England depends upon scientific research done in the present Believing that the Society itself is the best judge of the sort of work to be accomplished, he has made no narrow specification of the use to be made of it although he believes that the adequate payment of scientific workers and the provision for them of necessary apparatus is more important than the erection of costly buildings. The rules for the administration of the fund are to be revised at least every ten years.

The Earth's Electric and Magnetic Fields

QUITE apart from those more spectacular manifestations of atmospheric electric phenomena associated with the thunderstorm we have to recognize the following facts, as pertaining to the ordinary quiet day

The earth is charged negatively to such an extent as to give rise to a vertical potential gradient which amounts to about 150 volts per meter at the surface of the earth and goes through fairly regular variations throughout the day and throughout the year variations amounting to 50 per cent, or more in its total value

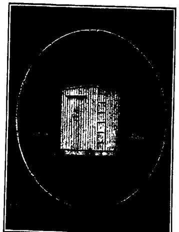
The potential gradient diminishes with altitude until its value at 10 kilometers is practically negligible compared with that at the earth's surface, a result which is brought about by the existence in the atmosphere, of a positive charge, the total amount of which below the altitude 10 kilometers is practically equal to the negative charge on the earth's surface

The atmosphere is a conductor of electricity The conductivity near the earth's surface is so small that a column of the air one inch long offers as much resistance to the flow of the electric current as would a copper cable of equal cross section extending to the star Arcturus and back twenty times over

In spite of the smallness of the conductivity of the atmosphere at the earth's surface its amount is nevertheless sufficient to ensure that 90 per cent of the earth's charge would disappear in ten minutes if there were no means of replenishing the loss.

The conductivity increases with altitude at such a rate that its value at an altitude of 10 kilometers is about fifty times that at the earth's surface, and there is indirect evidence to substantiate the belief that at altitudes of the order of 100 kilometers it may attain a value more than 10^{8} times that at the earth's surface Such a conductivity would cause the upper atmosphere to act, practically, as a perfect conductor in its relation to phenomena in the lower atmosphere

A potent factor contributing to the conductivity of the atmosphere is the radioactive material in the air and soil There are, on the average, about 1.5 molecules of radium emanation per cubic centimeter of the atmosphere over land yet this small amount is sufficient to contribute very appreciably to the ionisation there On the basis of the known amounts of radium and thorium emanations in the atmosphere and of radioactive materials in the soil we could account fairly well for the ionisation of the lower atmosphere The conductivity of the air over the great oceans is however, practically as great as it is over land, and is very much greater than can be accounted for by the radioactive materials, which are negligible in amount in the ocean and in the air over it The assumption of a penetrating radiation would provide a cause for the ionisation known to exist over the sea If however we are unwilling to admit the existence of such a radiation the ionisation over the ocean remains to some extent a mystery and may have to be attributed to a small spontaneous ionisation of the gas.—*From recent lecture before Franklin Institute by Prof W F G Swann Univ of Minnesota*



Half-section tube tunnels. These tunnels are driven by the shield method and consist of cast segments bolted together, the interior being lined with concrete

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

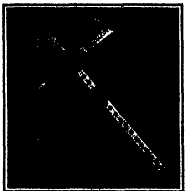
An automatic coffee dripper

Drip Coffee by Machine

AN automatic coffee dripper to make real French coffee that does away with the laborious process of pouring a teaspoon of water at a time into the pot has been invented by A M Lockett wholesale machinery man of New Orleans The construction and principle are shown in the picture Cold water is placed in the reservoir at the right The water passes through the pipe to the hollow base which is heated by electricity or can be placed upon an ordinary stove As the water boils it rises in the pipe on the other side and sprays out through the nozzle at the top upon the coffee in an ordinary French drip coffee pot A stop valve prevents the hot water from rising into the reservoir A small pipe exhausting through the reservoir and into the large pipe leading to the heating chamber takes care of the expansion when the nozzle opening isn t large enough to exhaust the full rush of boiling water and steam

The T-Square that Stays Put

A NEW combination drafting instrument uses a suction cup for holding it to any surface it is placed upon The cup is inflated by pushing on the knob of



Suction-cup attachment for holding drawing instrument to the board

the handle as illustrated It will hold the instrument to the board from ten to fifteen minutes The cup can be turned out of the way when not in use The instrument combines a protractor rule and T square All angles are quickly registered by operating the instrument around the pivot point which is the suction cup The holes in the rule are for chalk points and are placed every inch for describing circles

A New Method for Determining the Rate of Sulfation of Storage Battery Plates

STORAGE batteries have recently come into very extensive use particularly in connection with automobiles and anything dealing with the proper method of caring for such batteries is therefore of considerable general interest The life and efficiency of storage batteries depend upon the purity of the materials used in constructing the plates and on the purity of the electrolyte But little exact information is available on the effect of impurities in the solution which serves as the electrolyte and the methods ordinarily employed for determining the effect of such impurities are time consuming and often inaccurate

A new method has been devised by the Bureau of Standards for measuring the rate of sulfation of the plates resulting from local action This method is rapid and accurate but requires some special apparatus By this method a study has been made of the rate of sulfation of both positive and negative plates in solutions of varying concentration The results are described in Technologic Paper No 225 of the Bureau of Standards which may be obtained from the Superintendent of Documents Government Printing Office Washington D C at 5 cents a copy This paper covers the first step in a more extended investigation of the effect of impurities

Discussion of Logging and Safety Code

THE Bureau of Standards has prepared a discussion of the recently adopted safety code governing logging and sawmill operations This discussion is intended to explain why certain provisions are included and also in some instances to give further details concerning methods of safe operation. It will be recognized that this is in line with the discussions published on the National Electrical Safety Code, known as Handbook No 4 of the Bureau of Standards and the discussion of the Head and Eye Code entitled Handbook No 2 of the Bureau of Standards The discussion will be illustrated by photographs taken in the field by the Bureau s engineers by the United States Forest Service and various State commissions.

One interesting item in this discussion is the description of the V notch method of felling trees This was worked out by the Southern Pine Association for the purpose of preventing ' kick backs' of the butt of the log as the tree fell Not only was this method successful in preventing such "kick backs but when put in practice it was found that it gave larger yields of sound timber than the old method of making a horizontal cut A reproduction of the poster published by the Southern Pine Association is given in connection with the description of this method

Micrometer and Snap Gage in One

AN automatic spring driven measuring machine, controlled by contact with the object being measured, combines the functions of the hand micrometer and the limit snap gage It is an automatic micrometer having an operating range of 050 inches, an adjustable range of one-half inch and an interchangeable tolerance segment on the index arm It is automatically centered and squared on the work The micrometer spindle is automatically released, automatically set to a definite pressure and automatically locked to retain the reading as the instrument is withdrawn. It follows up successive reductions and is set back by hand to receive the next piece

The automatic action eliminates all need of skill or training in its use There are no micrometer scales to be read and interpreted. There is no reading to be remembered, drawing size to be subtracted or calculation to be made and no numerical tolerances to be considered For production use it is adjusted to read zero at the finish size It then reads directly on its dial the amount that the work is yet to be reduced The reading is automatically retained and the machine tool may be accurately set for the next reduction or the finish cut There is no guesswork or time lost in working down to size The operator gives all his undivided attention to the efficient reduction of the work within the acceptable precision as graphically shown on the tolerance plate

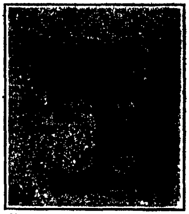
A measurement takes only two seconds with one hand It can be taken in any position and from any direction as there is no mechanism to be manipulated and the dial need not be in view The dial is large the scale open the lines and figures distinct and the zero in the same central position for all adjustments

It is always adjusted and used to the index line representing the exactly correct size of the product The user aims at the correct size and produces a substantially correct average size, while the tolerances are employed as the occasional extreme deviation conceded in the interest of rapid and cheap production

Method for Making the Interior of Automobiles More Comfortable in Hot Weather

ATTENTION has been called previously to a simple means for decreasing the heat radiated through a tent or other light covering which is exposed to the sun By coating the under side of the tent cloth with aluminum paint the heat radiated from the under side is reduced by 85 per cent. Painting the outside with aluminum paint was found to be slightly less efficient the heat radiated from the under side being reduced only about 80 per cent

Coverings of conveyances, such as, for example, the tops of automobiles ice wagons, etc consist of cloth, the outside of which is often painted with a black composition which absorbs perhaps 90 per cent of the sun s rays. Practically half of this is reradiated from the under side of the cloth Tests are in progress at the Bureau of Standards which show that a coating of aluminum paint applied either to the outside or inside of such tops reduces by 50 to 60 per cent the intensity of the heat radiated from the under side into the interior of the conveyance.



The automatic micrometer, that discharges also the functions of a limit snap gage

The Individual Radiator

HERETOFORE, in heating a single room that has no connection with a central heating plant for the entire house, it has been necessary to use a stove of some sort, radiating its heat directly into the atmosphere of the room Whether the stove be a wood coal or oil burner, whether it be used with or without a pan of water to maintain the proper degree of moisture content in the room, there are serious drawbacks to this procedure These seem to be avoided in the individual radiator which we illustrate herewith The bottom tank of gasoline feeds the two burners in much the same way as with the conventional gasoline or kerosene water heater These burners heat the air in the smaller cylindrical chambers above them and the hot air heats water in the larger cylindrical compartments just below the radiator A thermo-siphonic circulation is set up through the radiator, and the latter radiates heat to the room just as does the radiator of the conventional hot water heating system The radiator tubes are

The independent radiator for rooms that have no connection with a cen-

Clearing the kitchen drain without sending for the plumber

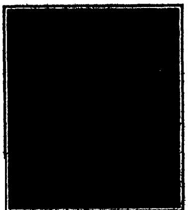
of copper. Fuel and water for a week's operation, it is claimed, are supplied at a single charging of the tanks. The apparatus is recommended, and is obviously of value, for isolated rooms and unheated apartments.

Accuracy of Analytical Weights

AN instance of sustained accuracy in the weights which are now being submitted to the Bureau of Standards for test was noticed during the past month. In a shipment of nine sets, containing a total of 216 weights, all were within the required accuracy. Only once before has a larger number of sets been submitted without some of the weights having errors greater than the prescribed tolerances. The fact that such shipments are now received, even if only occasionally, is an encouraging indication of the good work done by some American makers. It need not be said that such sustained accuracy would have been entirely out of the question as recently as ten years ago.

The Renewable Eraser

THE consumption of circular erasers in the ordinary office is very heavy, and these handy little correctors constitute no small percentage of the stationery bill. The metal holder and the brush (if the brush type be used) cost the manufacturer more than the abrasive business section, and, with this fact in mind, a Pittsburgh concern has put out a model designed to save these portions of the eraser ensemble from the waste basket. A new eraser goes into the old holder, just as a new pen goes in the old penholder. All that is necessary is to loosen the screw, make the substitution and replace the screw. We don't throw away penholders or drill handles; why throw away eraser handles?



The plow that uses the explosive force of the exhaust gases of the propelling engine to disrupt the soil

The Home Plumber

IN the best regulated families, coffee grounds and grease get into the drain of the kitchen sink and check or stop entirely the flow of water. The handy little aid to good housekeeping shown in the accompanying photograph steals a few plums from the plumber and enables the mistress of the house to clear out the pipes herself. It is used, as shown, with a little water in the basin of the sink. It works through hydraulic pressure, and is powerful enough to force down into the trap almost any accumulation that may be in the pipe.

Medicine to Breathe

PHYSICIANS often prescribe the inhaling of medicated vapors in treating coughs and other disturbances of the chest cavity, the nose and the throat. But a proper and continuous supply of the vapor, of uniform concentration, has not been easy to obtain. The croup kettles, steam atomizers and inhalers offered have been but halfway measures, lacking the proper efficiency.

A very clever invention has, according to the claims made for it, solved the problem. The idea is that of the old-fashioned lamp wick, but the wick does not carry the fuel. It carries, instead, the medicated liquid which it is desired to vaporize for the patient to breathe. It draws this from a reservoir, just as the lamp wick draws its oil. The wick in the radiodor, as the apparatus is called, however, passes over the surface of an electric light globe of a type whose luminous efficiency is rather low, and which therefore develops more heat than would be desirable if it were being used as a source of light. With the wick carrying the medicated liquid in minute but uniform quantities to the large, evenly heated surface of the globe, the fluid vaporizes at once and at a constant rate, and the patient is assured of exactly the atmosphere which has been prescribed for him. A larger and more elaborate model than the original one just de-

Don't throw away the handle of the circular eraser

scribed passes the medicated vapor through a water-soaked gauze cylinder, reaching the patient only after this filtering, and giving double assurance of a water vapor continuously and evenly medicated.

The Exploding Plow

SOMETHING new in plows is being marketed, based upon patents issued to Herbert Knight of New York. Instead of simply turning the ground over, the new implement shatters it, the pulverizing being accomplished by a series of explosions that takes place below the surface. The plow is propelled by a gasoline motor, the exhaust gases from which are conveyed through a suitable pipe into hollow cultivator teeth which extend into the soil. The lower ends of these teeth have suitable openings, through which the gases discharge with detonating force. The ground is thoroughly broken, the weeds torn out, and the earth left in a fluffy and highly aerated state. The detonating gases are mainly carbon dioxide, water vapor, oxygen and nitrogen, all beneficial to plant growth. The force of the explosions destroys fungi, undesirable animal life, eggs and larvae.

Convenience for the Smoker

A VERY complete and handy match box holder has recently been invented by E. R. Ganson of Columbus, Ohio. It is manufactured in two sizes, the smaller for safety matches and the larger, as illustrated, for double-tip matches. Both sizes have fireproof receptacles of ample size for the reception of burnt matches, as well as fireproof ash trays. Both are adapted for mounting upon any vertical, horizontal or inclined surface, or to set loosely upon a horizontal surface such as the top of a cigar case or counter. The small size is admirably suited for mounting upon the instrument board or windshield of an automobile. An empty box can be removed from the holder and a full box substituted in less time than it takes to tell about it. The match box itself is held securely in the most convenient half-open position, and does not have to be broken out at one end to facilitate the removal of matches. Both holders are made of sheet metal.

The electric vaporizer for medicated vapors

Methods of Measuring the Properties of Electrical Insulating Materials

SCIENTIFIC Paper No. 471 of the Bureau of Standards which can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents a copy, describes methods of measuring the properties of electrical insulating materials. This paper gives a series of electrical, thermal, chemical and mechanical test methods which have been found useful in the study of solid electrical insulating materials. The several tests described are those used in obtaining the data previously reported in Technologic Paper No. 216 of the Bureau of Standards entitled "Properties of Electrical Insulating Materials of the Laminated Phenol-Methylene Type." The several test methods described are radio-frequency phase difference or power loss, dielectric constant and flashover voltage, direct-current surface resistivity and volume resistivity, tensile strength, modulus of elasticity (tensile), proportional limit, modulus of rupture, modulus of elasticity (transverse), Brinell hardness, scleroscope hardness, resistance to impact, permanent distortion, density, moisture absorption, machining qualities, thermal expansivity, and the effects of heat, acid and alkali.

The methods and apparatus are described in some detail: first, so that the data in Technologic Paper No. 216 will be definite and be capable of being correctly compared with other data; second, so that any of the tests may be reproduced by others.

Tests of Radio Receiving Sets

THE results of tests of radio receiving sets by the Bureau of Standards are given in a series of Letter Circulars, the first one of which (No. 90) was issued a few weeks ago. This paper dealt with tests of electron tube sets. The second circular of this series (No. 93) is now ready for distribution and gives the results of tests on crystal detector sets.

It is believed that the methods followed and the examples given in these reports will be of assistance to manufac-

Fresh and burnt matches and ashes are all taken care of by this holder

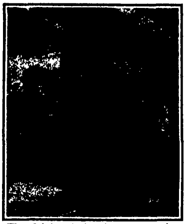
turers in the development of methods of testing besides aiding them to properly describe and improve their products. The particular receiving sets are referred to by arbitrary reference numbers rather than by manufacturer's name and type and model numbers. As these circulars are available only in mimeographed form, the supply is limited, but copies can be obtained by those directly concerned with the testing of receiving sets by addressing request to the Bureau of Standards.

An Indoor Draft for the Kitchen Range

WITH the apparatus of the accompanying drawing one of the ordinary stove holes in the top of the kitchen range may be used to secure an improved draft and a hotter fire. The "hot blast feeder," as its inventor calls it, takes the place of the stove lid, and he emphasizes that it doesn't occupy any more space than a cooking kettle, and is more ornamental.

The idea of the hot blast is to have an extremely hot nucleus in the fire, immediately below the discharge point of the apparatus. The fashion in which it achieves this is self-explanatory. An additional function may be got from it when slack or powdered coal is burned. The cylinder of the blast outfit, around the draft tube, may be filled with such material and will act as an automatic auxiliary feeder, insuring a continual supply of highly combustible fuel at the hot spot of the fire. This does not, of course, replace hand stoking of the stove entirely; it is simply an auxiliary arrangement, looking toward making the hot focal point of the fire even hotter than it would be possible to have it with the blast alone.

The hot blast device for making the kitchen fire hotter



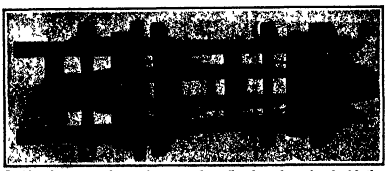
The driving light that can be instantly thrown, and held, upon any point of the road or the surrounding country

The Light that Shines Where It is Needed

FOR open or closed cars, the driving light which we illustrate gives a certainty of performance and an ease of operation which, the manufacturer says, can only be appreciated through actual use. The light is instantly rotatable to any point on a sphere, and will remain fixed in any position on the roughest road. The means for thus moving it is the control handle which is seen projecting from the frame of the car toward the driver. The slightest touch upon this handle changes the light from its normal position of straight ahead, to the ditch giving perfect illumination for the driver at the point where he needs it most in passing, while at the same time extending to the approaching car absolute freedom from glare. The electric switch is at the base of the control handle, in such a position that the thumb rests naturally upon it in grasping the handle, permitting a quickness of turning on and off never before attained. It gives a combination of the spotlight and the driving light which should be of the greatest value to all who are obliged to drive extensively at night.

Smooth Starting for Steam Trains

DETAILED description of the improvement in railroad couplings patented by Mr. E. W. Brown of Lancaster, Pa., would be out of place save in a railroad magazine, but a statement of what it does and in a general way how it does it should be of general interest. Everybody who ever rides on a steam train knows how the cars bump and jerk in starting, while the slack in the couplings is being taken up, and how the entire train heaves and buckles as each coupling straightens out, takes up its load, and gives the first yank to the car behind it. Mr. Brown would equip our cars with central longitudinal girders or frames, running from coupler to coupler. These frames would have a certain amount of play under the car, for which the inventor has made ingenious provision. When the engine gives its first forward impulse, the first coupling would go with it, as always, but instead of bringing the first car along, this would merely move the sliding girder-frame forward sufficiently to take up the slack of the second coupling. With this coupling in play, the same thing would happen under the next car, and the next, and the next, and none of the cars would tend to move forward at all until all the couplings were taut. Then the rear car would get the pull, would have no car behind to which to transfer it, and would start to roll forward, bringing the entire train into motion without jars or jerks.



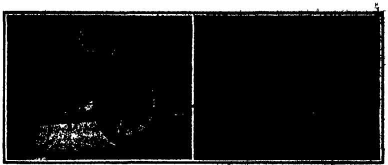
Looking down upon the running gear of a railroad coach, equipped with the apparatus that allows the couplings of successive cars to play against one another until the slack is taken up, so that the train may start without jerking

A Novel Demonstration

AN automobile's lubrication, in some measure at least depends upon gravity to make the oil flow over the lubricated surfaces, and this is true of cars having the most elaborate force-feed oiling in only less measure than of those relying upon the simple splash. So when a prospective purchaser lives in mountain country, it is a pertinent question for him to ask what effect continual running on heavy grades is going to have on the lubrication system of his car.

To prove that the oiling system would function under the severest handicaps, this demonstration car was run under its own power in the condition shown

A San Francisco agent for one of the popular lighter sixes recently staged a very clever demonstration covering this ground. As our illustration shows, he built a false bottom under the front end of his car, of such height as to tilt the machine to an angle of 32 degrees. With a steering gear that had been sufficiently tampered with to make the feat possible, he drove this fearfully up-tilted car for many days and many miles through the streets of San Francisco and Oakland, always under its own power. The complete failure of the oiling system to give the slightest trouble under this severe test is offered as proof positive that the car will get oil wherever it can go in California's mountains.



The automatic fender for cars and trucks, in driving and dropped positions

An Automatic Safety Fender

IT has long been contended that the high total of deaths resulting from persons' being struck by automobiles and trucks could be materially decreased by the invention of some sort of fender which would keep the victim of the accident from rolling under the wheels of the vehicle. In nearly every instance where death has occurred as a result of accidents of this nature it has been due to the fact that the person struck has been run over by the wheels before the vehicle could be brought to a stop.

A countless number of safety devices has been developed that claimed to work to this end. A recent one is of unusually simple construction, consisting of a bumper, a horizontal trip bar and an automatic fender. The trip bar is located an inch or two in front of the fender when driving, and the instant the person is struck it releases the fender, which drops to the ground and, by pushing him along in front of them, prevents the person's being crushed beneath the wheels. It is said to be impossible for the victim to get beneath the wheels of the vehicle, and the most extensive tests have served to bear out this contention, the fender never failing to operate.

When a body is struck the fender automatically releases and drops to the ground, thus pushing the body ahead of the truck and making it impossible for it to get beneath the wheels of the vehicle. The driver has his hands free to stop the vehicle, is not required to lift a finger to operate the fender and need pay no attention to it whatever, because, as the name implies, it is actually automatic in its operation.

To the thousands of car and truck drivers throughout the country who do a large amount of driving and who are always a bit nervous as to the possibilities of accidentally running into a pedestrian, this invention should be very attractive.

A Means for Increasing the Efficiency of Radiators

IN the last issue of the SCIENTIFIC AMERICAN, mention was made of tests in progress at the Bureau of Standards on the emissivity of sheet iron covered with white paint, glass enamel, aluminum paint, etc. These tests are of interest in connection with the question of heat radiated from the under side of roofing material, etc., when exposed to the sun. Data were given showing that a coating of aluminum paint emitted only 27 to 30 per cent as much as white paint, glass enamel, or other nonmetallic surfaces.

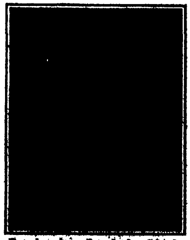
The application of this information to the painting of radiators for heating houses is obvious. But the gain in heating, by covering the surface with a nonmetallic paint, is not two to three times that of the aluminum paint, as might be inferred from the above-mentioned data. This is owing to the fact that an ordinary steam radiator is cellular in structure, which facilitates heating of the air by conduction and convection. The heat radiated from the sides is relatively of secondary importance.

Previous publications on this subject (Allen, *Electrical World*, 57, p. 1616, June 22, 1911, and *Jour. Am. Soc. Heating and Ventil. Eng.*, 26, p. 305, 1920) indicate that a radiator coated with aluminum paint emits only about 80 per cent as much as a radiator which is enameled or covered with a nonmetallic paint.

In other words, we may expect a gain of 15 to 20 per cent in heat dissipation by using a nonmetallic covering on ordinary house radiators. This is worth considering. The nonmetallic coating can be painted over the aluminum paint (if the radiator happens to have a coat of aluminum) which is a good conductor of heat and hence does not impede thermal conduction through the walls of the radiator.

The Talking Glove

THE curious glove which we illustrate herewith has two uses. The letters are marked upon it in the positions of one of the standard alphabets wherewith deaf-and-dumb people talk among themselves with such incredible speed. One learning the alphabet and its use may wear the glove for guidance until he acquires facility; and one who does not



For learning the deaf-and-dumb alphabet, or using it without learning it

Portable band saw specifically designed to work with either wood or metal

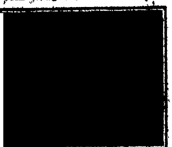
expect to learn it, but who must talk with a deaf-and-dumb person, may use it as a guide for his own speech and a means of translation of what is said to him. The letters are arranged, it will be noted, in a manner not entirely dissimilar to the universal typewriter keyboard.

A Simple Luggage Carrier

AN unusually effective luggage carrier has just been put out from North Tonawanda, N. Y. As our photograph indicates, without making the *modus operandi* exactly clear, the new carrier provides means for strapping with the utmost security to the running board anything of such size that the running board will carry it. The means of accomplishing this consists in the main of a metal strip, extending across the running board from the inside to the outside edge. At the inside edge it is securely bolted to the running board by means of a long bolt and a wing-nut. At the outside, the weight of the luggage which it carries holds it down. All along this strip there are oblong holes, into any of which the outer strap snaps with a snaffle hook. The inner strap snaps similarly into the upper end of the bolt member. The two straps are then brought around over the baggage, drawn as taut as may be, and buckled together. Photographs are shown us of a full-sized steamer trunk carried in this way for 8,000 miles, a suitcase carried 6,000 miles on end, to leave the door clear, and an outfit of baggage and camp equipment in nine pieces carried over 3,000 miles. In the latter case, four of the units were employed, with single pieces of baggage two seem always plenty. In any case, as many may be mounted as the exigencies of the situation demand, and the baggage is carried with complete security because, in the words of the manufacturer, it becomes for the time part of the car.

Each Coil a New Fuse

SOMETHING new in the way of renewable fuses has just been put out, and is illustrated herewith. The six coils of wire in the device represent six fuses, any one of which is immediately ready for connecting to the terminal after it has been straightened out. These coils are of standard fuse composition. We show the fuse with one coil straightened out and attached to the binding post, and the others waiting to be used in turn.



The newest renewable fuse outfit

The All-Around Band Saw

AMONG the season's novelties in the tool industry is a portable band saw for cutting wood and metal, put out by a Wisconsin manufacturer. It is claimed to be the only portable metal-cutting band saw on the market, and the only one that is specially designed for cutting both wood and metal. The illustration gives a good idea of the general character of this saw. Special features worthy of mention include ball bearings for the saw wheels, with upper wheel adjustable by sensitive hand-screw to insure perfect alinement. Tension on the saw-blade is controlled by another hand-screw, which works against a spring in such a way as to obtain uniform and cushioned tension. Incidentally, when chips and blocks fall between the saw and the wheel, this spring insures that they pass harmlessly around the wheel, without breaking the saw blade. The very efficient guard members swing out ward on a hinge, opening the wheels and the running blade to inspection and adjustment. For shaping jobs of all sorts in wood, steel, iron, aluminum, brass, fiber and hard rubber, the makers recommend the machine without reserve.

Spring Hangers That Are Different

ONE of the points where Tin Lizzie comes in for much abuse—both verbal and operating—is the front spring shackles. It almost seems as though the average driver had no realization at all of the fact that the weight of the entire front half of his car is suspended from the springs by these four little members. But whether he be inclined to do his duty by the shackles or to shirk it, he ought to find greater riding comfort with the suspension illustrated. This, it will be observed, substitutes for the single pair of shackles at each end of the spring a duplex effect, and it has a little auxiliary spring between the two points at which suspension is effected. The result is claimed to be a vastly better cushioning; and it certainly looks plausible.

Making the baggage part of the car

New Use for Mouse Traps

ACCORDING to the United States Department of Agriculture, the mouse trap has a new Government job. Finding English sparrows, which have been committing serious depredations on the immature corn and mungo beans growing in the experimental plats of the Federal experiment station at Honolulu, Hawaii, too wary to eat poisoned grain, the mouse trap was called into service. In the corn plats, the traps are wired to partly-eaten ears. For bait a soft kernel is used. When the bird attempts to eat the innocent-looking bait, the trigger is released and the pilferer caught by the head or neck. Death is instantaneous. For the mungo beans, the traps are also baited with soft corn and laid on the ground near the plants.

The Latest Stream-Lined Car

FROM Berlin, the home of the stream-lined automobile, there comes forth every now and then a brand new shape in which this idea is worked out in a different fashion. The very latest example looks a good deal like the domicile of the old woman who lived in a shoe, until one gets the proper mental and optical slant upon it to realize that it is really an automobile. In keeping with modern doctrine that the stream lining of the rear is of more vital importance than that of the front, the long wedge-shaped profile presented by this car is the stern, the prow is comparatively blunt. The wheels seem to be of the conventional disk pattern, apparently with no attempt to stream line their profile, which might seem a fatal omission. Our photographer assures us, however, that the weird vehicle has great speed—and, of course, that it "has taken years to perfect."

A novel spring suspension for the front system of the flivver

How Strong Are Hollow-Tile Walls?

IN a series of tests made by the Bureau of Standards in a 10,000,000-pound hydraulic testing machine, and described in Technological Paper No. 238 of that bureau, walls made of common fireclay tiles twelve inches long, twelve inches wide and either six, eight or twelve inches thick were tested to the point of failure. These tiles were first tested individually and their strength was found to be much greater than that of those usually used in building construction. Their design was such that all the net area was in bearing when carefully set on end in the wall. Owing to the fact that the walls were very carefully set by an experienced mason they are considered to have been stronger than those usually used in buildings.

Of the thirty two walls which were tested about half were built with the cells of the tile vertical and the other half with them horizontal. A few walls of each construction were tested under an eccentric load two inches off center.

It was found that considerable differences in the strength of the tile did not have an appreciable effect on the strength of the walls. No relation was found between the ultimate strength and the load at first crack. Walls having the cells of the tile vertical had on the average, more than twice the strength of those having the cells horizontal. Walls loaded with an eccentricity of two inches had about one-half the strength of similar walls axially loaded. Apparently this ratio is independent of the thickness of the wall.

An Electrically Lighted Gas Furnace in the Floor

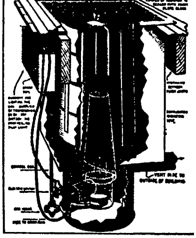
AN electrically lighted, fully vented gas floor-furnace is now offered, in which the entire control and lighting apparatus act as one. When the gas is turned full on, an electrical contact (low tension) is formed which gives a spark (high tension) in the plug. Lighting is thus positive and instant, without the use of pilot or matches. This should not be confused with the ordinary "electric push button control" which consists of a magnet valve and requires a pilot light to be burning constantly.

Stream-lining in its latest form—not a shoe, an automobile

The electric current is supplied by a four-cell dry battery and a standard spark coil. The spark plug is in a cast iron chamber and does not come in contact with the flame. If so desired, the battery may be eliminated by connecting the spark coil to a bell-ringing transformer of the proper size.

This gas furnace has many safety features. It has no dangerous pilot light, and the products of combustion are absolutely sealed from the room air, being drawn off through a concealed vent pipe. There is no danger from explosion, as the construction is such that it may be deliberately filled with gas and then ignited without harm or danger. This important feature is due to the entirely open design of base of the combustion chamber. The flame cannot be blown out by a down draught or back draught in the flue, as it burns within a cone-shaped combustion chamber and is, therefore, isolated from any side draughts. The effects of a back draught are cared for by the small safety vent holes in the lower portion, just below the flue outlet. In event of back draught the "dead air seal" drops slightly, thus uncovering the safety vent holes and allowing the backed up fumes to escape through them without smothering the flame. Should the gas be turned on deliberately without lighting it, there is no danger of its entering the rooms. There is no danger of fire, the box, insulated with asbestos, may be placed snug against the wood joists without the least danger—the box remains cool on account of the cold air-intake space entirely surrounding the hot radiator. The furnace is so simple and fool proof that a child can safely operate it.

The furnace is unusually economical in its operation—high efficiency being obtained by the method of passing the hot gases through wide, ribbon like corrugations instead of the usual tubes.



The fool-proof gas furnace to be installed beneath the floor

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

New electric truck chassis, showing accessible carrying boxes for batteries, suspended on their own springs to reduce shock

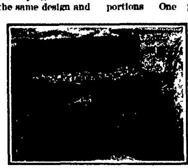
Electric Truck with Novel Battery Suspension

AMONG the season's new offerings is an electric motor truck in which the construction has in numerous ways been simplified to promote ease of operation and accessibility of all of the important units. The chassis is designed as a complete unit, with no part of it depending on the body. The dash, fenders, seats, etc., are included in the chassis price. The electric driving motor is mounted under the seat. It is hung in a heavy cross member, which also serves as a support for the front end of the battery. The motor is connected to the rear axle through a three-joint propeller shaft, which is supported in the center by a self alining bearing.

The outstanding feature of the new truck is the battery suspension. A sliding tray is provided by means of which the battery trays are mounted in a single master tray, which is on rollers in the cradle, and can be moved, without auxiliary apparatus, into a position where all of the cells of the battery can be reached for flushing or other attention. It is unnecessary to break any electrical connections to do this work, and the door of the battery box serves as a lock for the sliding tray. Means are provided for stopping the tray at the end of its travel, but these stops are easily detached when it is necessary to remove the entire tray from the truck. Therefore, for complete replacement purposes, the battery can be removed easily in two sections and a fresh battery substituted. The trays and compartments will accommodate regular and oversize batteries for the various models. Any standard battery can be installed.

It is difficult to design a structure successfully to carry such a highly concentrated load as a battery. For convenience in manipulation and to make all of the car platform space available for pay load, this mass should be hung beneath the frame. Such a construction brings the center of gravity of the battery close to the ground. With this relationship, it is not possible for the conventional springs to function properly in cushioning the battery and frame against shocks, and the normal accelerations and retardations from a rough road set up heavy stresses, both in the battery and in its supporting frame. These stresses are multiplied many times when the truck backs up against a platform or curb. In the new electric this problem is relieved by swinging the battery cradle in links to permit movement in the direction of the motion of the car, and with this movement opposed by springs, quite distinct from the chassis springs, a construction is obtained which eliminates shocks due to this suspended weight.

The new electric truck is unusual in other respects, not the least of which is the fact that it is put out by a concern that has for years manufactured gasoline trucks. The load-carrying elements of the chassis are of the same design and construction which have been tested by years of successful operation of these gas-driven vehicles. It is possible to install a body with the platform close to the ground, so that the load can be handled easily. The chassis is designed as a complete unit, with no part of it depending on the body. Two brakes are provided, the ordinary service foot-brake, and a hand brake for emergencies and for holding the truck when at rest. It is also possible to reverse the motor for emergency braking—a feature unique to the electric truck.



The battery tray moved out for inspection of the cells

A Self-Contained Kerosene Carburetor

THE fuel situation is more acute in England than it is in this country, as it is necessary to import the greater part of the fuel used in automobiles because there are no local sources of supply, if one is to except the shale derivatives and benzol, neither of which is produced in sufficient quantities to supply even a small part of the demand. For that reason, English truck designers continue their experiments with devices intended to burn lower grade fuels corresponding to what is sold in this country as kerosene.

A kerosene vaporiser operating on the partial combustion principle is used on certain trucks and was recently illustrated and described in our English contemporary, *Engineering*. The device is considerably smaller than other kerosene carburetors and is self-contained, that is, it does not require so-called hot-spot or exhaust-heated manifolds. The kerosene tank is connected to the carburetor intake, and is controlled by an ordinary carburetor float. From the float chamber the fuel travels into a passage in the body of the main casting, to which are connected a main jet and an auxiliary jet. The main jet terminates just above the level at which the float valve maintains the oil, but the fluid rises through the auxiliary jet into the bottom of a small secondary chamber. Fitting into the sides of this chamber is a casting, the bottom of which is pierced with a number of holes, each of which is filled by an asbestos wick. The lower ends of these wicks dip into the kerosene in the secondary chamber.

To start the engine from the dead cold condition, the carburetor cover is removed, by loosening the wing-nut which holds it, so that air has free access to the inside of the wick casting. A high tension spark is then passed from the spark plug to a piece of metal surrounding the wick directly beneath the plug. This ignites the wicks, which are allowed to burn for a minute or so, to warm the casting. The cover is then replaced and the engine is ready to be started. The spark is again switched on and the engine cranked round. The operation of cranking draws air through a small plate, which is perforated with holes. This air is separated into two portions. One passes directly down through the curved pipe and upward past the end of the main fuel jet. This is the main vaporising air which draws the kerosene out of the jet and carries it upward in the form of mixed vapor and spray.

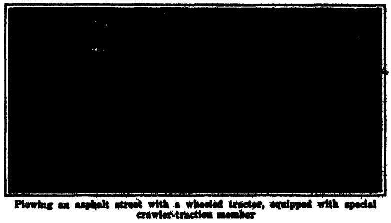
The other portion of the air is led to an annular space surrounding the wick casting and passes into the interior of this casting through the numerous small holes drilled through its walls. The presence of this air keeps the wicks burning after they have been lighted by the spark. A small part of the heated products of combustion passes upward, mixing with the pure incoming air to raise its temperature. The major part, however, passes out at a very high temperature, meets the kerosene spray as it emerges from the jet and completes its vaporization.

A baffle above the jet assists the mixture and forces the vapor into contact with the walls at a point where they are maintained at a high temperature by the hot gas or flame surrounding them. The mixture, and the additional air required for combustion, are controlled by separate butterfly valves, so connected that a richer mixture is automatically provided when the engine is "idling," and the mixture strength may also be increased above the normal under overload conditions.

It is claimed that the engine can be started within a minute or so from cold, without the use of gasoline or any means of auxiliary heating. As soon as the engine is firing, the spark in the vaporiser is switched off, as the passage of air over the wicks is then sufficient to keep them alight. Should they be blown out by a backfire, or become extinguished from any other cause, they can be instantly reignited by switching on the carburetor spark momentarily. When the engine has been running long enough to heat the water in the radiator appreciably, it may be stopped and restarted by ordinary cranking after an interval amounting to as much as a couple of hours, without removing the cover of the carburetor.

Crawler-Traction Member for Wheeled Tractor

JUST as soon as any automotive product is marketed in sufficient quantities so that its distribution is general, then other manufacturers devise attachments to increase the usefulness of the machine or to adapt it for certain work that it would not perform so creditably by itself. An attachment that is said to double the drawbar pull of a well known light tractor of the wheeled type that is made in large quantities, operates on the "crawler" principle and is designed to replace the traction wheels ordinarily supplied by the manufacturer. Needless to say, these traction members provide much more ground contact than wheels and can be used in soft and boggy soil where wheels, even with lugs and extension rims, would be at a marked disadvantage. Two widths of track are available, nine-inch, for use on hard ground, and twelve-inch, for soft places where more ground support is needed. The widest type has pressed steel grouters riveted to manganese steel links to increase the traction. It is stated that the attachment can be installed in place of the wheels in about an hour.



Plowing an asphalt street with a wheeled tractor, equipped with special crawler-traction member

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

PROPULSION MEANS FOR FLYING MACHINES.—A. E. BEEBE, Box 34, Cathay, N D The object of the invention is to provide propulsion means which is adapted to propel the flying machine either forwardly or upwardly, the direction of travel being thus readily varied by varying character of the action which is readily controllable. Another object is to provide propelling means which may be utilized to retard the descent of the plane.

AIRPLANE.—J S. SABEY, Paia Maui, Territory of Hawaii. The invention relates to an airplane that is supported in the air and uses the water as a means of propulsion The essential part of the invention is the propeller which is not arranged to rely on the air for a reacting means, its purpose being to engage the water, and it is secured in such a manner that the tips of the blades engage the water surface as a reacting means. (See Fig. 1)

Pertaining to Apparel

GARMENT —A. SILVERSTEIN, 817 Broadway, New York, N Y This invention relates to a detachable vest for coats. An object resides in the provision of a vest which can be applied to a coat with a minimum disturbance of the construction of the coat proper, so that the fit of the coat is in no way affected. A further object resides in the provision of means whereby the ends of the vest, when not in use, may be slipped in back of the coat facing and fastened therein, so as to have the appearance of an ordinary coat lining.

HAT RETAINING DEVICE.—O H LEMCKE, c/o Rogers Printing Ink Co., 404 W 27th St., New York, N Y The primary object of the invention is to provide a device for retaining a hat or other head wear securely in place and against accidental displacement from the head, the device affords ready means for detachably associating the same with a hat, cap, or head wear, and means for adjustment in order that the device may be applicable to heads of various sizes.

Electrical Devices

RENEWABLE PRIMARY DRY-CELL BATTERY —W S. DOE, c/o Doe Electrical Device Co., Kent, Ohio. The object of the invention is to provide a renewable dry-cell battery arranged to enable the user to readily disassemble the parts, renew the combined depolarizer and excitant or the zinc element, and reassemble the parts to again have an effective battery the same as originally placed on the market, the battery is exceedingly serviceable for use in self-contained electric lamps.

ELECTRIC CONTROLLING DEVICE. —W. W DRUMMOND, 328 No. Main St., Pratt, Kans. This invention has for its object to provide an electric controlling device for typesetting and other machines using a controlling keyboard, and arranged to permit an operator to selectively actuate the desired mechanisms of the machine without requiring much shifting on the operator's part.

3.—WHAT MAY BE PATENTED?

UNDER the constitution of the United States the Congress has been given power to promote the progress of science and the useful arts by granting for limited periods to inventors the exclusive right to their discoveries. Accordingly, under our statutes any person who has invented or discovered any new and useful *art, machine, manufacture, or composition of matter* may be granted a patent therefor By discovery is meant invention, and the term is not used in its generic or broader sense Likewise the word "art" is given a more limited meaning and in the sense of the patent law it signifies a process. In all probability the great majority of patents granted are for machines or other mechanical structures. Almost any machine when resolved into its component parts comprises a combination of old elements. If these old elements are combined in a new way or so as to produce a new or better result, the combination presents patentable novelty Just what is a "manufacture" in the sense of the patent law is difficult of definition. Broadly speaking, whatever is made by the hand of man and is neither a machine, nor a composition of matter, nor a design, is a manufacture. The term "composition of matter" may, according to Walker, be said to cover all compositions of two or more substances and includes, therefore, all composite articles whether they be results of chemical union or of mechanical mixture, or whether they be gases, fluids, powders, or solids. Not only for so-called "mechanical inventions" but as well for designs may patents be granted under our law and the statute provides that any person who has invented any *new, original and ornamental design* for an article of manufacture may obtain a monopoly thereof for a limited period. Design patents afford protection for the esthetic creations of the inventive mind and include a vast array of subjects. The period of the design patent as distinguished from that of the mechanical patent, which is seventeen years, may be three and one-half, seven or fourteen years.

Another object is to permit the use of the controlling device without the use of the usual keyboard, and to permit the removal of the device whenever it is desired to actuate the machine by the use of the keyboard

SOCKET COVER.—M. BERMAN c/o Reliance Metal Spinning Co., 160 John St., Brooklyn, N Y The invention relates to electric light fixtures, its object is to provide a socket cover so constructed that it may be adapted for use either with a ball or spherical lamp or with a pear-shaped lamp and shade as desired, without the necessity of dismantling and disconnecting the socket cover from the rest of the fixture, the cover plate being connected to the body portion of the socket cover by a detachable joint.

LAMP SOCKET.—C. GARCILLAN c/o Mrs. W Nunes, 228 W 48th St., New York, N Y The invention pertains more particularly to a method of constructing a lamp socket and the arrangement of the contacts thereof. One of the objects is to construct a lamp socket in such manner that the lead wires are in actual contact with the contacts of the lamp globe when the latter is positioned therein, one of the lead wires forming a means for supporting the lamp globe within the socket.

LAMP FIXTURE AND SOCKET CONSTRUCTION —A. B. BARNES, c/o Barnes Electric Mfg Co., 473 Central Park West, New York, N Y An object of the invention is the provision of means whereby the socket is in a simple and efficient manner connected to and clamped within the fixture. A further object resides in the provision of means whereby the support for the socket within the fixture and the device for clamping the parts, are utilized as a passageway for the switch operating means, which depends from the fixture.

ELECTRICAL SWITCHING DEVICE. —I L. STANGER, 573 E. Park Av , Merchantsville, N J This invention has particular reference to a combined switch or cut-out and fuse block in which the live parts are so enclosed that the danger of persons operating the switch coming in contact with them is reduced to a minimum, the live parts are also substantially enclosed regardless of whether the switch is open or closed or in any position. The fuses mounted in connection with this switch may be easily refilled and examined (See Fig 2.)

Of Interest to Farmers

SEED-DISPENSING MECHANISM FOR PLANTERS —G H WRIGHT, 1925 Pacific Ave., Spokane, Wash An object of this invention is to provide a reversible seed hopper, which may be utilized for dispensing various kinds of seeds, to provide a deflector which tends to increase the hopper's efficiency, and to suggest a slightly modified form of planter organization with which the dispensing mechanism may be used The size of the holes in the seed plates may be varied according to the kind of seeds to be planted.

PROCESS FOR REMOVING STUMPS. —J YEGEN, 416 Main St., Bismarck, N D The invention has for its object the provision of a process whereby a stump is converted into charcoal before being removed. The stump is bored to provide vertical air passages extending from the top of the stump to the space between the bottom of the stump and the soil Incomplete combustion of the wood is had by lighting the wood and covering the stump with soil

SEED COVERING ATTACHMENT FOR LISTERS —C. C HERMANCE and M. REIN, c/o Max Rein, Mutual, Okla. The general object of the invention is to provide an attachment adapted to be secured in position to run in the rear of the mold board and provided with means to form a center line seed trench in the lister furrow, and trailing covering means so constructed as to close the center seed trench by soil pressure instead of covering the seed largely by throwing the dirt over it, whereby the seed contact is uniform regardless of the speed of travel of the lister

Of General Interest

CLEANING FLUID FOR IMPREGNATING DUST CLOTHS AND THE LIKE.—F A WRIGHT 827 4th St. East, Hutchinson, Kans. This cleaning fluid consists of one gallon crude oil, one-half gallon gasoline four ounces raw linseed oil and a few drops of oil of cassia, mixed at a temperature of not less than 72° F The cloth is emersed in the solution, the surplus solution removed, and the gasoline allowed to entirely evaporate, it is then ready for use either on varnish, leather or glass.

CYLINDRICAL STRUCTURE AND BLOCKS THEREOF —F LE COCQ and I LE COCQ, Aberdeen, S D The invention relates generally to cylindrical block structures such as sewers culverts or conduits, the object being the provision of such a structure formed from blocks, whereby quick ready formation is brought about and a structure promoted involving a minimum of material, which will be water tight and capable of resisting internal and external pressure

WINDOW-OPERATING DEVICE. — A. HEYMAN, 239 18th Ave., Astoria, N Y An object of this invention is to provide means which will permit of the ready raising and lowering of the upper sliding sash of a window without the necessity of using sticks or standing upon a chair or other support. A further object is to provide a rod with threaded connection for ready disassemblage of the parts for removing the sashes the rod being neat in appearance, and efficient in use. (See Fig. 3.)

WINDOW DOG KENNEL.—C. CHAPLIN, 258 Madison Ave , New York, N Y An object of the invention is to provide a dog kennel adapted to be mounted on the outside of a window sill of an apartment house or other dwelling, and connected to the window frame in such manner as to be properly supported and protected from rain, the arrangement being such that access may be secured thereto at any time from the interior of the building (See Fig 4)

RACK.—W A HAMMOND, 112 Market St., San Francisco, Calif This invention relates to a rack designed for holding the blocks or tiles used in the game of "mah-jongg" The rack comprises an elongated block of material having an inclined frontal ledge and face allowing the tiles to rest on the ledge in a slightly reclined position, and a back face substantially parallel to the front face allowing the rack to be turned or the same without disturbing the file arrangement.

PHONOGRAPH REPRODUCER DIAPHRAGM —C WHITEFIELD Victoria, B. C, Canada. One of the foremost objects is

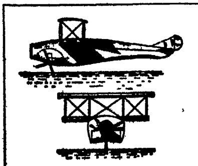


Fig. 1. J. S. Sabey's air-flying plane, driven by water screw

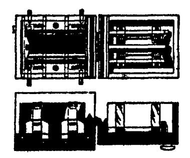


Fig. 2. Safety combination of switch and fuse block, invented by I. L. Stanger

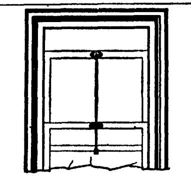


Fig. 3. The invention by which A. Heyman opens and closes the top sash

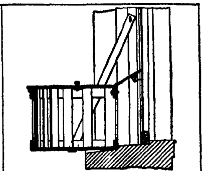


Fig. 4. Dog kennel, designed by C. Chaplin, to be mounted on the outer window sill

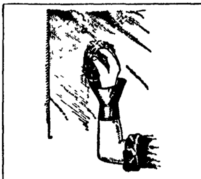


Fig 5. Keeping the window-washer's arm dry with J P Kelly's invention

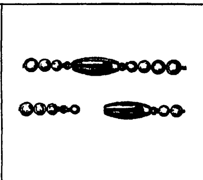


Fig. 6. J R. Starck's version of the jewelry clasp that opens easily when desired, and not at all when not

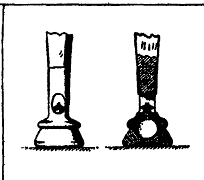


Fig 7. Better cushioning of the shock of impact is the claim made by W G. Bell for this crutch tip

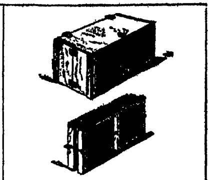


Fig. 8. Collapsible crate for shipping live stock, invented by J. W. O. Orban

to provide a reproducer diaphragm composed of a plurality of suitably assembled wooden sectors, so treated before assembly as to confer qualities thereto which enable the diaphragm to render perfect reproductions, and so mounted on parchment as to produce sounds of a high degree of faithfulness, due to the arrangement and resonance of the wooden sections.

RECEPTACLE.—F J Lynch, c/o Peerless Tube Co, 28 Walsessing Ave., Bloomfield, N J The invention aims to provide a receptacle particularly adapted for use in connection with the shipment and storage of photographic cartridges, or spools and similar articles, but not necessarily limited to this particular use, by means of which a container will be provided, which will virtually preclude any damage occurring to its contents incident to atmospheric conditions or moisture.

BOX.—C A Fox, 276 6th Ave., New York, N. Y. The aim of this invention is to provide a receptacle comprising a lid and body, the elements of which will co-operate with each other in such a manner as to effectively preclude the entrance of dust or foreign matter, or the possibility of withdrawal of any of the contents of the receptacle without either visibly injuring the receptacle, or entirely removing the lid, thus necessitating the destruction a sealing means.

SNOW GUARD AND FENDER.—H N Siegler, 211 E. Church St., Slatington, Pa. The invention relates to guards for preventing a large volume of snow collected on a roof from sliding therefrom The principal object is to construct the guard or fender in such a manner that the same will have a bearing on a plurality of adjacent shingles in order to distribute the load for preventing damage to the roof as well as to insure a strong connection

REPAIR DEVICE FOR FISHING RODS—D McC Hudson, Bend, Oregon The primary object of the invention is to provide means by which repairs to fishing rods and similiar articles may be made It is a further object to provide means whereby the tips, ferrules, and the like, of fishing rods and similar articles may be securely fastened in place in such a manner that they may be readily removed when desired

BOTTLE CAP REMOVER.—T C Rush, c/o Hay Hardware Co Lexington, Ky An object of the invention is to provide a bottle cap remover of extremely simple and effective construction which may be readily attached to a support and positioned in such manner that, when not in use, it will occupy a minimum space and form no outwardly extending projection beyond the base of the device.

HAIR WAVING DEVICE.—O. J Hungerbuhler and C Schopps, 782 Quincy St., Brooklyn, N Y Among the principal objects of the invention is the provision of a core member for permanent hair waving devices which effects a wave of gradually increasing size from the root to the outer end, more closely resembling the natural wave. A further object is to provide a device which eliminates the necessity of tying the hair at the roots, and which admits of an expansion of the hair after being applied to the core.

WATERPROOF CARRYING CASE.—J D Kelly, 98 Whitney Ave., Elmhurst, N Y An object of the invention is the provision of a waterproof case especially designed for bathers, which is adapted to contain cigarettes, matches, cosmetics, money, or the like, which is provided with means for attaching the same to a beach costume whereby the wearer may enter the water when the case is closed, with assurance that the contents will remain dry

SANITARY TOILET SEAT COVER.—J L. Schaeffer, 80 North 30th St., Flushing, N Y The invention relates to covers for toilet seats and aims to provide a sanitary covering element which is designed to be destroyed after having been once used in order to insure the user against contact with the seat and against infectious diseases or the like; the device is simple and may be inexpensively manufactured.

POCKETBOOK. — B. Stember, 1261 Broadway, New York, N Y The invention more particularly relates to ladies' pocket books, hand bags, and the like, in which a main change receptacle serves for the carrying and supporting means of a plurality of pockets arranged on either side thereof. Among the objects is to provide a hand-bag with a pocket of the accordion type and a safety pocket upon the exterior of the frame of the bag

FIREPROOF TANK.—W. S. Huff, 2113 W Maple St., Stock Yards Sta., Oklahoma City, Okla. Among the objects of the invention is to provide a fireproof tank for holding oil and other inflammable liquids, the basic principle being a cover or floating tank on the oil with suitable means for sealing the joint between the floating tank and the outer stationary tank

GAS-REGULATING VALVE.—L. E. Troscelair, 2622 Lavender St., New Orleans, La. The invention has for its object to provide a valve which is operated by varying pressures of steam in a boiler to automatically diminish or increase the flow of gas, but at the same time prevent the flow of gas to a burner from being entirely stopped, this last provision functioning like a pilot.

LUNCH HEATER AND CARRIER.—J. Weiss, 1418 N Halsted St., Chicago, Ill. An object of the invention is to provide a lunch heater and carrier, which may be placed over a fire to warm the contents, the carrier being so constructed that the fire cannot burn the food A further object is to provide a device in which the different kinds of food are kept separate, the device when assembled forming a compact unit.

DESK ORGANIZER.—R. J Turner, c/o Efficiency File Co., 218 So. Clark St., Chicago, Ill. The invention relates to a device having means for conveniently receiving, in classified order, various papers and letters such as ordinarily gather on the desk of a business man. This device is constructed in such form as to make it particularly adapted to hold a plurality of papers without losing its shape or assuming a bulky appearance.

SEALING RING—L. Foot, Pedro Miguel, Canal Zone, Panama. An object of the invention is to provide a sealing ring which is adapted to form part of a liquid shaker and to be interposed between the mouth of a pair of ordinary glass tumblers, sealing the mouths of both, to form a shaker, the ring being simple in construction, easy to clean and efficient in use.

CONTAINER.—A. H. Bosworth, Zoeia Bldg., Wichita, Kansas. Among the objects of the invention is to provide a container or receptacle for receiving compositions, such as menthol, to be used as an inhaler, it being possible to make the container with a minimum number of parts and yet result in a strong compact article produced with a minimum expenditure of time and labor.

MOP WRINGER.—E. P. Poulsen, Mendham, N. J. The invention has particular reference to a mop wringer which is designed to be associated with a bucket or pail to remove the majority of water and discharge the same in the pail. A further object is to provide an adjustable device whereby the same will operate in connection with buckets of various heights, and may be expeditiously associated with or removed from the bucket.

BOOK-HOLDER.—M. J Caffrey, 319 W 126th St., New York, N. Y. The invention especially pertains to a book-holder adapted for attachment to an article of furniture, such for instance as a chair, bed or the like. The primary object is to provide a form of book-holder which may be adjusted to various angles to meet the requirements of the article to which it is attached, and to provide means for keeping the book in open position.

CHANNEL BRICK.—A. Hardoncourt, c/o Munn, Anderson & Munn, Woolworth Bldg, Broadway, New York, N Y The object of this invention is to provide a construction of channel brick employing a novel form of grip for handling the brick, the sides of the channel being so shaped that the mason's thumb and fingers may readily obtain a good grip without danger of injuring his knuckles against the rough surfaces of the brick, the brick is strong and is not unnecessarily weakened by the forming of the channels.

WRISTLET—J P Kelly, 207 Eighth Ave., New York, N Y The invention relates to a protector adapted to be used in washing painted surfaces, windows, etc. The primary object is to provide means adapted to be worn upon the arm of the operator to catch the drip from a sponge, cloth or other washing implement. The device may be readily attached or detached from the wrist of the operator, it is constructed in such manner that one of the edges is flared, and will keep this position while in use. (See Fig. 5.)

FAUCET.—T Coonan, Morgan Hotel, Detroit, Mich. One of the principal objects of the invention is to provide a faucet which for the filling of glasses, cups or the like, is adapted to operate automatically in that the valve of the faucet may be opened by positioning the glass or cup under the mouth of the faucet and in engagement with the operating mechanism, the faucet being also adapted to operate as a non-automatic fixture, and may be manually operated for the filling of buckets or large containers.

CLASP FOR JEWELRY—J R. Starck, Weehawken, N J The invention pertains more particularly to a clasp for connecting together the ends of necklaces, bracelets, and the like. One of the primary objects is to provide a clasp which will be securely held against accidental displacement of the members relative to one another, a further object is to provide a clasp which may be readily opened and closed. (See Fig. 6.)

TIP FOR CRUTCHES.—W. G. Bell, 1410 M St. N W., Washington, D. C. The object of this invention is to provide a crutch tip adapted to serve as a pneumatic cushion to absorb the shocks which may be imposed upon the end of the crutch. A further object is that the tip be adapted to grip the surface upon which it may contact during the use thereof. The tip is adapted to be inflated to any degree desired. (See Fig. 7)

FOLDING CASE.—J. W. O. Orban, 824 Locust St., Scranton, Pa. This invention relates to folding cases, crates or coops, which, when in set up condition, are designed for the purpose of shipping animals or poultry, and are also designed to be collapsed when empty for the purpose of reshipment, whereby the same will occupy a minimum amount of space. One of the principal objects is to provide a case in which all of the elements are permanently connected to prevent possible loss. (See Fig. 8.)

FREE CHAIN HOIST.—F W. Coffing, c/o Love & Kilgore, 204 Daniel Bldg., Danville, Ill. The object of the invention is to provide a chain hoist wherein the chain operates through a frame so as to be housed and protected. A further object is to provide a chain hoist in which the chain and frame are so organized with each other and with the driving mechanism that the heavy stresses are evenly distributed thereby endowing the hoist with features of strength and durability

CONTAINER.—F B. Wendel, 3010 Clarendon Rd., Brooklyn, N. Y. This invention relates to containers for powdered or granulated materials such as spices, condiments or the like. The object is to provide a closure which affords means for sifting the contents in quantities, which closure is rotatably mounted on the top of the container for selectively shifting the same to its various discharge positions.

ROLLED BELT LACING—H. Hemmerdinger, c/o J H. Hemmerdinger & Son, 422 Withers St., Brooklyn, N Y An object of the invention is to provide a simple package whereby a plurality of rolls of belt lacing may be packed away in a neat manner so that in displaying or using the belt lacing an individual roll can be extracted for use without the necessity for unwinding a large roll, or disturbing the package.

JUVENILE BLOCKS.—W C. Hailey, cor 116th St. and Morningside Ave., New York, N. Y The invention relates to a set of blocks arranged to rest upon the projecting ends of the white keys of a self-playing piano, and having upon their faces amusing pictures of humans and animals, to simulate dancing and jumping figures, said blocks being cubical in form, and also embodying spacing blocks to be interposed between the cubical blocks, all the blocks being operated by the up and down movement of the keys of the piano while playing a piece of music.

DENTAL ARTICULATOR OR RELATOR.—J Homes, 144 Commonwealth Ave., Boston, Mass. The invention has for an object the provision of means whereby the manipulation of the articulator is made easy, and in making a given set of teeth the operator can form an impression of the movement of the teeth with respect to the other jaw which can be preserved in a permanent fixed form for future use and thereby enable other teeth to be made in a much simpler manner.

CONTAINER.—P. G. Ross, Poultney, Vt. The invention particularly relates to liquid containers, the object being to provide a container so constructed that there is no danger of pressure from the inside of the container blowing out a cork or other closure. A further object is to provide a container from which the cork may be readily removed without danger of injuring the same.

ANTIVERMIN BED.—L. Novak, 382 E. 78th St., Apt. 34, New York, N. Y. Among the objects of this invention is to provide means which are intended to be employed for use in connection with a bed and bedding for the purpose of trapping bed-bugs and such insects. The device may be incorporated with the bed when manufactured or may be applied to beds already constructed.

CHICKEN-BROODER COOP.—C. G. White, Delhi, Iowa. The general object of the invention is to provide a brooder coop

constructed as to keep the chickens free from the stamping of an uneasy hen when the chickens are shut in, as in the early morning or on a rainy day. The device is also vermin proof, and proof against the attacks of small animals. The construction is of knock-down form, and may be readily assembled.

BATHING CAP.—L. and M. AUSTER, 39 E. 27th St., New York, N. Y The invention relates to caps particularly intended for use by women bathers, to avoid the annoyance caused by wet hair, and its injury due to the action of salt water Among the objects is to provide the wearer with means of being relieved from the uncomfortable pressure of the cap against the ears, due to tension when the cap is expanded beyond its normal size and contracted against the head of the wearer. (See Fig. 9.)

COMB.—R. B. HOWARD, Golconda, Nev The object of this invention is to provide a comb construction in such manner that the teeth are easily separable to permit an expeditious and efficient cleaning of the comb. It is also an object that the teeth be so made that in case one of them becomes broken a new one may be easily substituted therefor. The comb is simple and inexpensive to manufacture. (See Fig. 10.)

Hardware and Tools

ROASTING FURNACE.—J THOMAS, 210½ W. Heron St., Aberdeen, Wash. The invention aims to provide a roasting furnace which may be operated by any desirable type of fuel. A further object is to provide a device which may be readily portable, and in which the construction is simple, provision being made by which the degree of roasting may be regulated to a nicety A further object is the provision of a device which may be of sectional construction so that the parts may be assembled to conform to operate with the type of material to be operated upon.

FURNACE FOR STEAM BOILERS FOR BURNING RESIDUAL MOLASSES. —H. A. GRIFFIN, Box 613, Honolulu, Hawaii. The invention relates particularly to a steam generating apparatus which will burn and thus utilize for steam generating purposes residual molasses and like products of waste fluid, the object being the provision of a simple effective apparatus capable of ready extension in its adaptability to steam boilers of various widths and applicable in a simple manner to boilers of various types. Among the purposes is to uniformly feed the molasses in such manner as to promote combustion of maximum efficiency

BOUDOIR LAMP—F W LAUKS, 177 Montague St., Brooklyn, N Y The invention contemplates an inexpensive, highly attractive and ornamental illuminator preferably in the form of a doll having a hollow translucent body in which an electric illuminating means is arranged for obtaining in a subdued and temporary illumination in a bedroom, the body of the doll figure being provided with movable members constituting the means for rendering the lighting means active.

SPRING COMPRESSOR.—C A. PRESCOTT, 147 Riverside Ave., Providence, R. I. An object of the invention is to provide a device of this character with which a valve spring may be quickly compressed, and to provide means for holding the spring in compressed position when it is removed from the compressor. A further object is to provide such a device which is simple, strong, durable and efficient in use.

CHAIN TIGHTENER.—F V FISCHER, Glenrock, Wyoming. An object of the invention is to provide a device which may be used to tighten all types of chains. A further object is to provide means for taking up the slack in chains where it is impossible to further tighten the same manually, and to positively lock the chain in tightened or stretched position

LATHE CENTER.—DE WITT E. HOWARD, Box 26, R. F D No. 1, Ridgewood, N J The general object is the provision of a simple and durable lathe center in which the work receiving spindle is revolubly mounted in a hollow body in such a manner as to prevent any play, and providing in conjunction with the hollow body means for forcing the means for mounting the work receiving spindle out of the body, the work receiving spindle being rotated on ball bearings.

COMPASSES.—U JOHNSON, 288 Martense St., Brooklyn, N Y Among the objects of the inventor is to provide an instrument which may be used for ordinary work in the usual manner, but which will embody a construction permitting of work or drawings being readily divided into desired proportion, the operator being able to readily duplicate a piece of work from one standard scale to another standard scale.

LEVEL ATTACHMENT—L W TIFFANY, Winsted, Conn. The invention aims to provide an attachment suitably utilized in connection with levels such as are used by carpenters, and other mechanics. An object is to provide an attachment by means of which it will be possible to determine the height, or a distance in a given plane between one point and a second point, without the necessity of utilizing the services of an expert engineer

BATH AND BASIN FITTING—F C. DARLING, Walton, N Y The invention relates to stoppers for waste pipes in bath and basin fittings. The primary object is to provide a receptacle for the reception of the stopper in order that the same may be concealed from view when not in use, the receptacle being so constructed that the stopper will be moved automatically to position.

TORCH—I M HAYWARD, 5024 18th St. Brooklyn, N Y—This invention has for an object to provide a construction which may be quickly arranged as a torch or as an automatically heated soldering iron, wherein alcohol may be readily used as a fuel. A further object is to prevent the heat from unduly affecting the liquid part of the fuel while at the same time presenting means for conveying the fuel to the heated part of the torch for gasification

Heating and Lighting

BOILER AND HEATER.—P O ROTH, 3400 Cornelia St., Brooklyn, N Y An object of this invention is to provide a means for causing the water in a steam boiler to absorb more of the heat units passing through the flues, the arrangement being adjustable to take care of different conditions of fire, boiler and the like. A further object is to provide baffling or deflecting means for the boiler tubes which may operate any desired series of baffles, and an arrangement of air or steam injection which will tend to produce a better combustion and better draught.

FURNACE APPLIANCE.—O L. RUNDELL, 603 Woodland Park, Chicago, Ill This invention relates to furnace combustion appliances. An object is to provide a device in which oxygen is conveyed from the furnace grate to a point above the burning coal, thus assuring the combustion of the gases above the coal A further object is to provide a device in which the parts may be readily replaced, if broken, and in which a protective sleeve is provided for that portion in close contact with the hot coal.

METHOD OF CONTINUOUSLY MELTING VITREOUS ENAMELS.—F D COOK, Box 459, Washington, Pa. The invention aims to provide a method of forming vitreous enamels which consists in utilizing a melting chamber formed to prevent collection of the melted enamel in a pool and permit the enamel to run continuously from the chamber as it melts, in continuously withdrawing and quenching the melted enamel and in controlling the temperature by this process.

FIRE KINDLER.—J QUIST, 855 Howard St., Detroit, Mich This invention relates to a device for starting fires in stoves or furnaces where coal or other solid fuel is employed for heating The object is to provide a device adapted to be applied beneath the fire grate in the ash receiver for rapidly starting a fire, the lighting unit comprising a receptacle and a multiplicity of upstand ing sheets of liquid absorbing material, such as asbestos, filled with a suitable oil

Machines and Mechanical Devices

PLECTRUM PIANO ACTION—G CASCIOTTA, 317 E. 27th St., New York, N Y An object of the invention is to provide a novel piano action capable of being substituted for a conventional piano action constructed in a new piano and by means of which the same tonal qualities will be capable of being duplicated by means of a piano as are now capable of being rendered only by a performer upon a harp.

LOADING AND UNLOADING APPARATUS.—J A WORSHAM, Maroa, Ill An object of the invention is to provide a portable loading and unloading device particularly designed for loading freight cars or the like, and for handling ear corn, but may also be used for loading various other materials. The device is automatic in its operation, causing the tilting of a wagon to discharge its contents into a hopper, and causing the material to fall into a pneumatic discharge tube through which a blast of air distributes the same to evenly load the car

AUTOMATIC DRILL PRESS—C. E. Cox, 610 Park Ave Rockford, Ill Among the objects of this invention is to provide a device in which there is an arrangement for elevating and lowering the drill spindle, and a magazine in which a plurality of tools may be carried with means for bringing any desired tool into operative relation with the drill spindle, and means for locking the tool carrying mechanism in position for releasing it at will

SEPARATOR.—M M NEWTON Colorado Springs, Colo The invention relates to an apparatus for separating a conglomerate of solids consisting of materials having different specific gravities such as found in mining operations for redeeming precious metals from sand and gravel beds or from tailings of a mine or the like The device comprises a helical shaped pan having a transversely curved surface, means for supporting and adjusting the pan for rotation with respect to the axis.

DRILLING MACHINE.—H C BREWSTER, Shreveport, La An important object of the invention is to provide a well drilling apparatus having a sub or suspended bed arranged beneath the main bed and the rotary table of the machine, the bed being provided with suitable means for gripping a drill stem or pipe to hold the same against rotation independently of the rotary table

SELF CONTAINED BLOW OFF VALVE—C H STROUD, Hubbell Mich The invention relates generally to valves and more particularly to blow-off valves, the object being the provision of a self-contained valve, the moving part of which will be fully concealed and movable within the limits of a casing and are protected from outside influences, as well as from accidental blows.

FLUSH TANK VALVE.—S KNEPPEL, 333 E. Locust St., Scranton, Pa. The general object of the invention is to provide a tank valve adapted to be lifted by a pull exerted on a chain or lever The device is characterized by accuracy of operation and the facility with which the parts may be produced and assembled, as well as to obtain simplicity and durability of construction.

PUMP—D H THOMPSON, 314 W Locust St., Lodi, Calif Among the objects of this invention is to provide a positive acting, continuously operating, combined suction and pressure pump having a continuous suction and discharge that is economical, simple and substantially built. The capacity of the pump will be contingent only upon the power exerted in operating

FLUSHING VALVE.—W S WHITE, Denver, Col The invention has for its object to provide a valve which comprises a piston and a pendant valve movable vertically relatively to the piston to function in a particular manner, an important result being that the flow of flushing water will not cause the valve to bind. The device also includes an auxiliary valve for venting a chamber above the piston

HAIR WAVING MACHINE.—J M HIGGINS, 1223 15th St., Sacramento, Calif. The particular object of the invention is to provide a machine that will enable a person to produce a Marcel wave on her own hair in a very short time, without the assistance of an attendant, and without the exercise of any particular skill The device is simple and will produce the required wave in a few minutes.

PUMPING POWER.—E. S SLOAN, Shippenville, Pa The invention relates more particularly to what is known in the oil well art as pumping powers. An important object is to provide a pumping power which employs an extremely heavy base into which is rotatably extended a main shaft surrounded by a suitable number of relatively stationary bearings so that the leverage cannot exert an excessive friction and thereby decrease the life of the bearings. (See Fig 11)

Medical Devices

BLEEDING APPARATUS.—R. F. SCHNEIDER, 125 Manhattan Ave, Jersey City, N J The invention relates to bleeding apparatus commonly used for extracting blood from the body for the purpose of making blood tests. The device includes a handle having a passage therein adapted to communicate with a hypodermic needle, a rigid nipple fixed to the handle and communicating with the passage and a flexible airtight coupling member adapted to hold the reduced breakable end of a vacuum tube within the nipple

TONSILLOTOME.—O C. DANIELS, Oriental, N C The invention relates to surgical instruments adapted for use in severing and removing tonsils, like portions of the body, and abnormal growths An object is to provide an instrument which is simple in construction, adapted for convenient disassembly and replacement to permit of cleaning, or the sharpening of the cutting blade. A further object is to provide an instrument having relatively adjustable members adapted to grip the parts to be severed whereby the parts will be securely held in position, the device is adapted to be operated with one hand (See Fig 12)

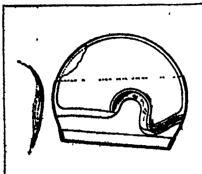


Fig. 9. The improved bathing cap for ladies, designed by L. and M. Auster

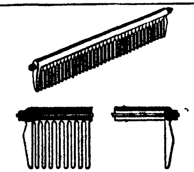


Fig. 10. R. B. Howard's comb with separable teeth to facilitate cleaning

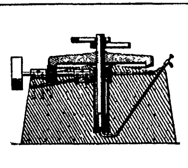


Fig. 11. E. S. Sloan has patented this better arrangement for pumping in oil wells

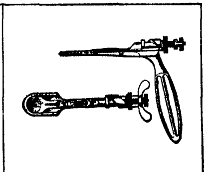


Fig. 12 Improved instrument for removing tonsils, the invention of O. C. Daniels

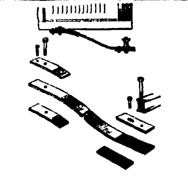


Fig. 13. Axle-alining radius-leaf adjustment invented by G C. Robbins

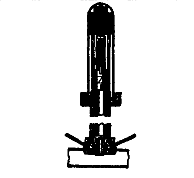


Fig. 14. W E. Hedges's tire valve that indicates the pressure

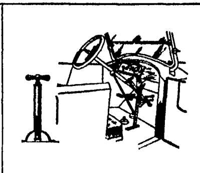


Fig. 15. Attachment by means of which E. B. Preston is able to relieve the foot on the accelerator pedal

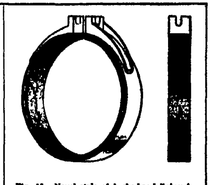


Fig. 16. Novel style of brake-band lining invented by R. Reynolds

Musical Devices

MUSIC ROLL CONTAINER.—R. V O Neill, 1839 Westchester Ave, Bronx, N Y This invention seeks for its principal object to provide a container for music rolls which includes a means to permit the playing of the role without removing the same from the box. Another object is to provide a container which includes means for reducing friction to a minimum, and preventing wear on the container proper

MUSICAL NOTE-INDICATING ATTACHMENT—G W Stewart, 325 W. 48th St, New York, N Y This invention has for an object the provision of means whereby a person may very readily learn to play and read music A further object resides in the provision of means whereby a musical instrument may be provided with means on its body portion to indicate a musical scale or notes in connection with which the attachment is operated.

Prime Movers and Their Accessories

LUBRICATING DEVICE.—H C Shamblin, c/o Shamblin Lubricating Co., Webb City, Mo The invention aims to provide a lubricating system for use in connection with internal combustion engines by means of which an operator may adjust the supply in such manner that just the correct amount of lubricant will be utilized and evenly distributed so that all of the objections in this connection will be avoided The device may be manufactured and applied at a nominal figure

COMBINED COOLING AND CARBURETING SYSTEM FOR INTERNAL COMBUSTION ENGINES.—A J Charlton, Lowden, Iowa An object of the invention is to provide a cooling system which may be applied to any engine having the usual water jacket, but which dispenses with the use of water, thereby reducing the weight and eliminating the necessity of a radiator A further object is to provide a cooling and carbureting system in which cold air is forced through the water jacket, and the air thus heated conveyed to the carbureter

ACCELERATOR.—C Hammond and W Inman, Boyne City Mich The invention relates to accelerators for use on internal combustion engines. Briefly stated the object is to provide an accelerator for Ford motors having means whereby the same is operated automatically by the depression of either the clutch or reverse pedals, the device may be applied without elaborately altering the construction of the engine.

CLEANING IMPLEMENT—G A Hoyem, Lennep Mont The aim of this invention is to provide a device particularly adapted for use in connection with the cleaning of spark plugs and by means of which an operator will be enabled to effectively clean all of the parts of the plug without going to the necessity of dis-assembling the same The device is extremely simple and can be manufactured at a nominal figure

GAS ENGINE—O Nelson c/o Dr D P Teter, 2000 Irving Park Bldg., Chicago, Ill Among the objects of the invention is to provide a simple and efficient timing means for gas engines. A further object is the provision of means for drawing a full charge to a point—adjacent the working cylinder by means outside of said cylinder, and to provide means for opening and closing the ports of a gas engine in definite relation with each other

SPARK PLUG—J S Solomon, 125 Magnolia Ave., Los Angeles, Calif A spark plug comprising a plurality of electrodes permanently adjusted and arranged to provide a succession of spark gaps which function to intensify the spark in the aggregate and to prevent fouling of the plug.

TIMING INDEX—V W Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn The invention relates to internal combustion motors, and pertains more particularly to means for indicating the relative position of the cam shaft and its driving mechanism to the crank shaft of the motor One of the objects is to provide means whereby the several parts of the cam shaft and its assembly may be properly positioned, in order that when the connection between the crank shaft and the cam shaft is made the several parts will be in properly timed relation

ROTARY FLUID-PRESSURE PRODUCING APPARATUS—A. J Worthen, Station C, Box 1654, Los Angeles, Calif The invention relates to compressors in which the velocity of the air, gas or other fluids is converted into pressure energy and its object is to provide a rotary fluid pressure producing apparatus arranged to obtain a high over all efficiency and reduce mechanical losses and losses of fluid, due to windage, to a minimum, and deliver a large volume of air or gas at a high compression ratio

Railways and Their Accessories

BEARING CONSTRUCTION—V W Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn Among the objects of the invention is to provide means for centering bearings and particularly the main bearings of internal combustion motors, and to provide means which serve also to automatically center and retain the bearings in position after the same has been centered A further object is to provide a device which may be readily assembled and disassembled.

ROTARY INTERNAL COMBUSTION ENGINE.—S. B. Collier, Voughton Seed Co., Jersey City, N J The invention relates to internal combustion engines of the rotary type, the primary object being the provision of an engine which will be economical and practically without vibration in operation A further object is the provision of an engine, the disposition and operation of certain parts of which preclude leakage, thus maintaining a uniformly high compression at all times.

COMBINED ATOMIZER AND VAPORIZER FOR OIL ENGINES.—A. C. Smith, 2058 E. 38th St, Los Angeles, Cal. The purpose of the invention is the provision of a combined atomiser wherein the atomised oil is injected either into the vaporised member or directly into the cylinder of the engine, so that when starting the engine or running under a light load the vaporising member is employed to effect a thorough vaporisation of the fuel, while, on the other hand, when the engine is heated to effect the flushing of oil, as it is introduced into the cylinder, or when the engine is running under heavy load, the oil can be ejected directly into the cylinder and without contacting with the vaporiser

TWO STROKE INTERNAL COMBUSTION ENGINE.—W J F Wege, 67 Third Ave., St. Peters, South Australia, Australia. The invention comprises a two-stroke internal combustion engine for use with oil, petrol, alcohol, benzine or other volatile fuel. It is very simple in construction and operation and has no valves other than port valves. All valve operating gears consisting of cams, camshafts, tappets, tappet rods, rockers, valve guides, valve timing wheels and springs have been eliminated, it is especially adapted for airplanes, motorcycles and

Pertaining to Recreation

AMUSEMENT DEVICE.—J Isson and J. Markey, c/o Flickenstein, 601 5th Ave., Long Island City, N Y The invention has for an object to provide a construction wherein the players may see the effect of their efforts during the progress of the game, and wherein a number of objects are caused to travel from one part of a track to another through the manual operation of an actuating mechanism, which if not properly operated will fail to perform the desired function.

GAME APPARATUS.—K. O Stromme, 465 H St., San Bernardino, Calif. An object of this invention is to provide a game apparatus consisting of blocks or rectangular game pieces having numerals thereon arranged in such manner that a game or games may be played which exercises the mental faculties in problems of arithmetic and which constitutes a game of skill as well as of chance The game may be played by children or adults and lends itself to a wide variety play to exercise the player's ingenuity.

GAME.—R. Doner, 120 E. Ohio St., Chicago, Ill An object of the invention is to provide a device in which certain moving parts are manipulated in a manner to ascertain the score of the players, the device having a dial and an indicator hand, both of which are movable relative to one another and to the supporting means. The score may not be predetermined by an unfair manipulation of the device.

Pertaining to Vehicles

DOOR HANGING AND SECURING MEANS.—J H Stewart, 99 Woodward Ave., Rutherford, N J Among the objects of the invention is to provide a freight car door adapted to have lateral movement to or from the doorway in addition to its sliding movement, whereby to effect a tight fitting of the door in the doorway. The general object is to provide a suspension means for the door, whereby the door may be readily opened and quickly and tightly closed

LIFTING DEVICE.—F G Cline, 311 W Adams St., Neosho, Missouri. The general object of this invention is to provide a lifting device for application to the Ford automobile, so constructed as to be adapted for engagement with the front cross member of the frame for repairing the steering gear, wheels, etc., or for lifting the side frame bars, or the rear end without damaging parts of the car body in the various necessary operations of repair.

TIMER.—E. J Lee, c/o Never Break Products Co., 8 Murray St., Bangor, Pa. This invention relates to a timer including a ring, a contact member encircling said ring, antifriction means interposed between said ring and member, a collar carrying the ring, a plate carried by the collar and expanding outwardly therefrom, and a spring pressed pin carried on the outer end of the plate and bearing against the contact member.

VEHICLE SHOCK ABSORBER.—G Henley, 362 E. College St., Meadville, Pa. An important object of the invention is to provide a shock absorber which is especially adaptable for use on automobiles in connection with the front and rear springs, which may be equally as well applied to various types of automobiles in an effective manner and which so absorb the shocks due to rebound or recoil that jarring will be substantially eliminated, and especially the upward

OIL INDICATOR AND PUMP PRIMER.—G F Madden, Roosevelt, Utah. The invention is intended for embodiment in oil indicator reservoirs employed on automobiles. The general object is to provide an indicator reservoir so formed and connected up with the pump that oil will be received in the reservoir from the pump and oil from the reservoir may be returned directly to the pump when required, for priming the latter

AUTO ATTACHMENT—H. D Cook, 2204 Cleveland Ave., Terre Haute, Ind. Among the objects of the invention is to provide a simple attachment for felloes of wheels of ordinary construction which are adapted to act in conjunction with the felloes to permit of a demountable rim being locked in position or released as quickly for dismounting therefrom The device is adapted to be applied without any change being required in the wheel.

ADJUSTABLE CHAIN HOOK.—O E. Brown, 51 Ferguson Ave, Buffalo, N Y The aim of the invention is to provide an adjustable coupler or hook, for employment in any suitable relation, but for use preferably on the circumferential chain member of an anti-skid chain The hook is of simple and rugged construction and easily adjusted to take up slack in a chain and lock the same against accidental disengagement.

RADIUS LEAF—G C. Robbins, Blowing Rock, N C. The invention relates generally to radius leaf adjustments adapted for use with the front axle assembly of vehicles, but the adjustment may be used to advantage on other kinds of machinery One of the principal objects is to provide a radius leaf adjustment by means of which the axle of a vehicle can be readily alined, the leaf being securely associated with the chassis and axle after adjustment so that its capacity to carry out the functions of a rigid radius leaf are in nowise impaired. (See Fig 13.)

SAFETY VALVE AND PRESSURE INDICATOR FOR AUTOMOBILE TIRES.—W E. Hedges, Box "C," Waupun, Wis. This invention relates to the air valve for the inner tubes of tires, and the general object is to provide a tire valve having an assemblage functioning as a pressure indicator in the pumping up of the tire and functioning as a safety valve for the relief of undue pressure under excessive heating of the tire. (See Fig. 14)

ATTACHMENT FOR MOTOR VEHICLES.—E. B. Preston, Mexico, Missouri. The invention relates to the accelerator control of internal combustion engines. An object is the provision of an attachment for the accelerator pedal by means of which the operator is able to relieve his foot, and use one of his hands for operating the pedal. By this device the operator may use his foot in cases where it is desired to lower the pedal for a short interval, or may use the adjustable hand attachment for maintaining the lever in the desired position for a long period. (See Fig. 15.)

BRAKE-BAND LINING.—R. Reynolds, 29 Glencoe Place, Cincinnati, Ohio. The invention relates to a method and manufacture of a form of brake-band lining such as are employed upon motor vehicles or the like. The object is to provide a lining adapted to be associated with any standard form of brake band and serve in a highly efficient manner as a friction braking medium with a relatively long "service life." The lining is adapted to be made without any loss of the friction material constituting the same. (See

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Automotive

The Gasoline Shortage Scare which swept the country a year or two ago has been greatly minimized by more recent investigations. Already gasoline substitutes are playing an important part in automotive development in foreign countries. Researches into the production of fuel have been made by low temperature distillation, by the use of benzol, by the hydrogenation of naphthalene, by the study of various uses for tar acids for motor fuel, when converted, and by the treatment of coal with ozone and its conversion into liquid products by the Bergius process.—*Automotive Industries* 49:9 pp. 432-35.

Eucalyptus Oil as a Motor Fuel has been experimented with in Australia. C. M. Dyer is said to have demonstrated that it can be used in petrol engines with efficient means of vaporization. The only difficulty he has encountered is that it will not start an engine from cold without priming. But its calorific value is high. Tests made with cheap cars which showed 24 miles to the gallon with gasoline, showed 28 miles with half gasoline and half eucalyptus; and 36 miles on eucalyptus oil alone. Eucalyptus oil mixes with gasoline, benzine and alcohol and acts as a decarbonizing agent. The main difficulty of manufacture on an extensive scale would be in securing laborers to gather the leaves.—*Industrial and Eng Chem*, 15:9 p. 807.

Gasoline Blends, listed in the order of their importance, are benzol, kerosene, alcohol and ether, these being mixed with the gasoline in various proportions. Since benzol is obtained chiefly as a by-product in coke-ovens, distribution centers of benzol blended gasoline are to be found exclusively in cities which support industries requiring coke-ovens on a large scale. But as the sources of benzol increase, more and more use will be made of this very desirable fuel. Even though costing more per gallon than plain gasoline, the blended fuels give greater power, greater economy in fuel consumption, better operation of the engine, so that the total cost of operation is less than with gasoline in spite of the higher price per gallon. All considerations of cost may be swept aside if a fuel is superior in starting, accelerating and reliability. But it has not been demonstrated that any blended fuel is superior to good gasoline at prevailing prices. If gasoline increases to fifty cents per gallon, an alcohol benzol kerosene mixture, high in alcohol, would have commercial possibilities. Blended fuel is worth perhaps two cents more per gallon, but a price differential of three to five cents is not justified by the advantages gained.—*Mech. Engineering*, 45:10, pp. 577-78.

A New Water-Cooling System for Automobile Engines, known as the Lonergan system, which includes a condenser for steam formed in the cylinder jacket, a novel form of radiator construction, characteristics which are said to prevent injury due to freezing, and means for rapid thawing out if frozen up, has recently undergone tests which appear to have demonstrated the ability to produce satisfactory cooling under severe conditions. Either a pump of the usual centrifugal type or thermosiphon circulation has been employed. A positive pump is not required. Neither is any pressure relief valve needed. This system has a tight filler cap, and the only opening to the atmosphere is the vent at the top of the condenser. Water from the bottom of the radiator enters the cylinder jackets either by pump or thermosiphon action, no special pump being employed. The hot water and steam pass over to the top of the radiator, where condensation and cooling take place. Part of the steam goes to the condenser, where the condensate soon forms a water-seal. When the engine is throttled down, [illegible] the cooling blast of air is accelerated sufficiently to make condensation more rapid than evaporation, a partial vacuum occurs in the top of the radiator and returns the water from the condenser.—*Automotive Ind.*, 49:12, pp. 581-82.

The New, Low-Pressure or "Doughnut" Tires have received a very favorable reception at the hands of French motor-car manufacturers. These tires have clincher bead cord construction. The bead is stiffer and deeper than on the ordinary tires, but the sidewalls are very much thinner. Recommended pressures are fifteen pounds per square inch for the smaller sizes used on two-seater cars, and eighteen pounds for the larger tire on four-seater models. These are lower pressures than other makers who have experimented with large-section tires have considered advisable to adopt.—*Automotive Industries*, 49:12, pp. 581-82.

The Annual Sale of Motor Cars in Australia now amounts to about 16,000, and since the buying capacity of nearly every Australian is probably slightly higher than that of the average American, the demand will grow. Cars in Australia are used essentially for business purposes. American makes of cars and trucks predominate, and it is estimated that 75 or 80 per cent of the motor cars sold in Australia are manufactured in the United States or in American factories established in Canada. Under the stimulus of high tariff duties, body-building and tire manufacturing have grown to be very important industries in Australia. At present, Adelaide is the seat of the motor body industry. One Adelaide plant alone employs over eight hundred men, and turns out ten thousand motor bodies a year, which is about sixty per cent of all the motor bodies manufactured in the country. Fifty per cent of all the tires and tubes sold in Australia are made there, and half of the remaining fifty per cent come from the United States.—*Amer. Machinist*, 59:13, p. 480.

Civil Engineering

Storing California's New Oil.—Within the last twelve months there have been completed in southern California new oil tanks with a combined capacity of 14,500,000 barrels, and new reservoirs with a combined capacity of 21,500,000 barrels. The storage now building amounts to over 8,750,000 barrels in steel tanks and 28,000,000 barrels in concrete-lined, earthen reservoirs. In the Los Angeles basin, seventy-five cents per barrel may be taken as a fair unit cost for building steel storage, and thirty-five cents per barrel for concrete storage.—*Mining and Oil Bull.*, 9:9, pp. 752-755.

Utilization of Methane Gas from Imhoff Tanks.—Since the time when sludge chambers were first used in sewage disposal it has been known that the gases developed were useful owing to their high content of methane, marsh gas or fire-damp. The gases have not been much utilized in the past because it was considered necessary to build large roofs above the water level to collect them. There has recently been constructed in the Ruhr coal district the first large municipal sewage works with provision for collecting all the gas produced. In the new type of vent-chamber there is constructed, about three feet below water level, a nearly horizontal roof which has an opening in it about three by two feet in size. Over this opening a funnel-shaped gas hood is placed, the bottom edge of it projecting about one foot below the surface of the water. In a year's time a quantity of gas equal to 0.[illegible] cubic feet per capita per day can be secured. A city of 100,000 can figure on 11,000,000 cubic feet of combustible gas per year. Among other uses, this gas is very useful for welding and cutting, as it is free from [illegible]. The added cost of the gas-[illegible]

ing apparatus amounts to one per cent of the cost of constructing the Imhoff tank plant. In the Ruhr the receipts from the sale of the gas covers over half of the total operating costs of the Imhoff tanks.—*Eng News-Record*, 91 18, pp. 512-14

A New Method of Measuring the Flow of Water in Conduits is based on obtaining a record of the changes of pressure that occur in a conduit when the water therein is brought to rest. Steady conditions of load on the turbines are maintained as uniform as possible When the usual observations of head, power, etc., have been made, the turbine gates are gradually and gently closed so as to shut off the supply of water to the turbine. Immediately preceding and during the closure of the gates and for a short time afterward there is obtained a record of time intervals and of the changes of pressure that occur in the conduit. This record is obtained by means of the Gibson apparatus, which is connected through the wall of the conduit by a piezometer opening at any convenient point upstream from the turbine casing After the closure, when the disturbance in the penstock has subsided, the same apparatus is used to record the static pressure then existing in the conduit The complete record is called the pressure-time diagram, and when properly interpreted is a precise measure of the mean velocity of the water in the conduit at the moment the gates began to close Measurements made at the hydraulic laboratory of Cornell University showed that the mean variation from volumetric measurement was less than 0.2 per cent, and the maximum variation of any one measurement was 1 6 per cent—*Engineers and Engineering*

Locomotive Smoke in Tunnels is the subject of investigations made by the Bureau of Mines in tunnels of the Union Pacific Railroad This work was the outcome of several accidents which occurred to train crews passing through the tunnels, caused by pollution of the air by exhaust gases from freight locomotives. Gas samples and temperature readings were taken and the symptoms and physiological effects produced on the crews were studied Pulse rates and body temperatures were taken, and the determinations of the carbon monoxide content of the blood were made It was found that in a normal running time of six minutes through one tunnel the temperature rose to 114 degrees F, and the relative humidity was ninety per cent Physiological tests showed that an exposure of 4½ to 8½ minutes to atmospheres containing 0 05 to 0.29 per cent carbon monoxide produced a blood saturation of five to eighteen per cent. Smoke deflectors decreased the temperature of the cab atmosphere twenty to thirty degrees. The results of physiological tests over periods of ten minutes showed that the conditions in the cabs might be severe enough to cause asphyxiation or exhaustion in twenty minutes, especially in cases where the engine is stalled. It was found that the train airbrake line may be used as a source of air for breathing purposes for a period of ten minutes, and in combination with the air tanks in the train pipe, acting as a reservoir, will afford a supply of pure air for thirty minutes.—*The Railroad Herald*, 27 9, pp. 37-38.

Japanese Engineers have tended to make a steel building which would be sufficiently rigid in itself to move as a single unit without distortion among the several parts. The main difference in construction details between the Japanese and American designs lies in the columns, the connections of the beams to the columns, and particularly in these elements as they occur in the outside walls of the buildings. The spandrels are unusually heavy and are fitted with diagonal bracing tying them to the columns in a way calculated to prevent any relative movement between the two. The column splices are exceptionally heavy and in some cases are as long as a story height. As many as four splice plates, with close to 260 rivets through them in four rows, are fitted on each side of the column. All these buildings are erected on the sand underlying Tokio. They are carried on piles forty to sixty feet in length. The footings of stone concrete, with a large amount of stone reinforcing, are poured around the heads of the piles and the individual column footings are tied together by reinforced concrete beams, forming in effect an enormous mesh with space between members equal to the column spacing. A reckoning of the steel buildings in Tokio gives one steel building which measures 331 by 300 feet, and is eight stories high. Another measures 152 by 286 feet, and is seven

stories high A third is 158 by 180 feet and is seven stories high. There is also a fourth seven-story building. In addition, there are half a dozen five and six story steel buildings. In Yokohama, none exceed three stories.—*The Iron Age*, 112 11, pp. 685-86.

Shaded Topographic Maps have been experimented with by the United States Geological Survey since several years. With the recent production of shaded topographic road maps of the region of Washington, D C the Survey has made a further step to improve the legibility of its regular topographic maps by shading. The combination of shading and contouring is considered to be well adapted to use for regular engineering purposes. A number of sheets in West Virginia and Pennsylvania are in course of preparation and it is intended to publish them in the near future as a means of securing an expression from users as to the value of this method of showing relief If opinion is favorable, other maps in various parts of the United States will be produced. The shading is so applied as to produce the effect of a sculptured relief model under oblique illumination Dark tints of color are used for low lands and lighter tints for high lands. Where the topographic survey of a state has been completed and published maps exist, a shaded relief map on the scale 1 500,000 will be prepared. Such a map has been made, for instance, of Ohio.—*Eng Record*, 91 10, p. 382.

A South American Railway Development which will probably cause important changes in trade routes is the Salta-Chile extension of the Argentine State Railways, now under construction, to connect with Antofagasta. The object of this line is mainly the development of the northwestern provinces of Argentina, which comprise one of the most promising regions of the world for extensive development, being capable of producing practically everything grown in tropical, sub-tropical and temperate zones. The line will carry a large part of the imports now going to Buenos Aires from the United States, as they will probably seek the shorter route.—*Eng News-Record*, 91 9 pp. 332-36.

The Two-Strip Highway consists of two 8-foot slabs of concrete with a center strip four feet wide of oil macadam, and two 2 foot shoulders of macadam at the sides. The two-strip type of highway is safer for driving at night because of the plain demarcation of the road —*The Highway Mag*, 14 9, p. 10

Asphaltic Concrete for Road Foundations.—A study of western construction reveals the fact that during the last ten years great strides have been made in road foundation work, particularly through the extensive use of the foundation family known as "black base" or asphaltic concrete. Upward of 15,000,000 square yards has already been laid and has proved successful. East of the Mississippi, foundations of this type have been used in only a few widely separated places. Asphalt is used as the binding material in black base construction, and broken stone or gravel is used as the aggregate The ductility of this base prevents cracking and disintegrating from the expansion caused by temperature changes. Its flexibility assures constant, uniform contact with the subgrade and gives to the pavement its maximum bearing and carrying capacity for the traffic load. It is claimed that the reduced cost of maintenance with this type of base is even greater than its other advantages. When depressions occur it is unnecessary to remove the entire base to repair it.—*Am City*, 29 3, p. 234

Industrial Progress

Gas is becoming an increasingly potent factor in the baking industry Recent developments have made the direct-fired gas baking oven a real competitor of the coal-fired oven Cost of fuel is not the proper basis on which to compare the two kinds of baking ovens. That gas-fired ovens are preferred in spite of a higher fuel cost is demonstrated by the steady increase in its popularity among the bakers. In 1920, the first large, continuous, direct-heated gas oven for the baking of bread was placed upon the market. Today, more than 100 traveling plate bread ovens, direct-heated by gas, are in operation or in course of construction in Canada and the United States. The weight of the direct gas-heated oven can be held down to practically one-fifth that of the flue oven. This simplifies installation, reduces expansion and facilitates heat insulation. The upkeep costs are lower and if repairs

are necessary, the oven can be cooled in a few hours instead of days.—*American Gas Journal*, 119 8, pp. 155-56.

A New Southern Industry.—In 1915, 1916 and 1917, when the quest for resources for every industry was at its height, engineering surveys showed that millions of dollars lay dormant in the unworked resources of the South The War focussed the eyes of the balance of chemical United States on the southern states. The railroads took up the cry at first with the idea of developing the territory along their routes. Various chambers of commerce of different localities put their shoulders to the wheel Within five years, as a consequence, what was once considered a dream of the far distant future has become, with startling rapidity, a reality Particularly in chemical manufacturing, plants have sprung up all over the South, many of them since the end of the War, manufacturing everything from proprietary medicines to coal tar distillates and sulfuric acid—*Manufacturer's Record*, 84 11, pp. 71 72

The Cost of Bricklaying Labor is the target for considerable unfriendly comment in the newspapers, but because the day's work of the bricklayer can readily be expressed in the form of a unit of work—brick laid per day—a unit of work easy to check and easy to discuss, his production is too often mentioned in a deprecatory way by those who are dissatisfied with building labor in general. Most people fail to remember that the bricklayer, in common with all other craftsmen, now works eight hours a day instead of ten and that the record amount of brick laid per day, which sticks in their memories, was probably laid in a wall thicker than the walls are built today and that the thicker the wall the faster the brick are laid—*Common Brick Mfr's Assn*

Balsam-Wool is a new heat insulator which is being used for the construction of ice boxes and refrigerators, and in the building of comfortable homes. This material weighs only three pounds per cubic foot, less than half as much as balsa wood and about one-fourth as much as cork. When tested for thermal conductivity, balsam wool showed the remarkable thermal conductivity of 6.1 B.t.u, as against 8.3 for balsa wood, and 7 4 for fine cork. These latter are the most efficient heat insulators made from wood heretofore known. Patents were granted on both the product, balsam wool, and the process of making it and it is now being made in Minnesota. About 2,000,000 square feet was used in the construction of homes throughout Minnesota last fall and the returns coming in from home owners show that the product is saving these home owners from thirty to forty per cent in coal. The waste parts of logs are shredded and boiled in an alkaline solution to loosen the cementing material which binds the wood fibers together The fibers are then combed one from another in a beating engine. Now the fibers are rebuilt, but in a different arrangement. First they are fireproofed pressed partly dry and blown against a traveling wire screen, where they are mixed with cement and cemented, with the fibers projecting in all three dimensions. The fiber sheet is now made up into a "sandwich" with asphalted kraft-paper on either side, rolled up and sold. Similar heat insulators are made from hair, seaweed, flax straw, waste sugar cane, pulp screenings, etc., but none of them, except, possibly, hair is as heat resistant as the new product made from the fibers of coniferous trees. No balsa wood enters into the composition of the balsam wool.—*Chem and Metall. Eng.*, 29 12, pp. 534-36.

The Skoda Works, which supplied Austria with most of her guns during the war, and which occupied a position in Austria somewhat analogous to that of the Krupp works in Germany, is now situated, owing to relocation of national boundaries, in Czecho-Slovakia. Where, before and during the war, these shops were bristling with long-range guns, dreadnought turrets and other implements of war, today one sees the construction of locomotives, newspaper presses, milk-separators and similarly peaceful and productive work. The great Skoda works employs nearly twice as many workers as it did before the war The total yearly capacity of the great factory is 316,000 tons, which is distributed among such items as cast steel, electro-steel, ingots and blooms, cast iron, brass, aluminum, forgings, car wheels and axles, gearings, motor car parts and only about 15,000 tons of heavy ordnance and ammunition This item is for the small army of Czecho-Slovakia and for that

of Jugoslovakia. Most of the output is for peaceful purposes.—*Amer Machinist*, 59 14, pp. 519-24.

A Coal By-Products Plant is being erected at Ford, Ontario, which will recover from the coal several useful elements. First, the coke, which will be burned in pulverized form under the power-plant boilers. Second, the surplus gas, of which about 4,000 feet will be recovered per ton of coal This will be used in the forging and heat treating operations required in the preparation of the high grade steel for motor cars. Third, sulfate of ammonia, which is one of the cheapest and most valuable forms of fertilizer known. Fourth, creosote, a chemical in great demand as a timber preservative. Fifth, gasoline and kerosene, of which a maximum of twelve gallons will be recovered per ton of coal, and which contains all the properties of true kerosene and gasoline Sixth, lubricating oils and grease —*Canadian Mfr.*, 43 9, p. 26.

The Windmills of the Netherlands are making way for the less picturesque but more dependable Diesel engine. Steam and electricity are by no means a recent development for pumping water in that country, but the Diesel engine has the advantages of instant readiness, reduced operating labor cost, lower fuel cost, and independence of power supply and of power rates. When rain starts to fall one does not know how long it will last With the steam plant one is obliged to wait till the water shows a rise that makes pumping necessary and then get up steam The oil-engine, on the other hand, can be put into service immediately and it is possible to have the polder level constantly at the right mark. Several dozens of oil-engines are in use in the Netherlands for polder drainage, ranging from 20 to 400 horsepower and pumping against a head of three to seventeen feet. Nearly all of these plants are working with centrifugal pumps, but some use the Wood-screw pump. To give a rough comparison of wind and engine power the old windmill of Steins drove a paddlewheel pump, and to drive the wheel when the wind fails, a forty horsepower Diesel engine was installed —*Oil Engine Power*, 1 110, pp. 482-88.

Tobacco and Mental Efficiency is the subject of a publication of the Committee to Study the Tobacco Problem. The World War increased the use of tobacco and we now use nearly seven pounds per capita per annum. The production of cigarettes has risen from 3,500,000,000 in 1905 to 46,000,000 000 in 1918. Experiments made at the University of Wisconsin showed that the pulse rate is almost invariably accelerated after smoking. Muscular control was lessened on an average of 42 per cent. Rapidity of addition was increased by 1 per cent. Accuracy was decreased by 5½ per cent. The use of tobacco is injurious to the mental development and efficiency of the immature and growing individual, but no positive opinion can be expressed concerning the adult, although laboratory tests show that in almost every reaction tried tobacco had an injurious effect.—*Am Jour Pub Health*, 13 9, pp. 763-64

Steel Furniture for the Home is being developed by a New York manufacturer of beds. Steel office furniture is not new, but the present program, though limited to bedroom furniture, is a comprehensive one, including nine distinct suites, consisting of ten or eleven separate pieces. They comprise a dresser, chiffonier, chifforette, chifforobe, full vanity, semi vanity, bench, chair, rocker, bedside table and dressing table. The present production of these articles is 800 pieces a day, but with the completion of a new plant during the winter the output will be increased ten-fold The materials used for making the furniture consist largely of two classes of steel, cold-finished sheets and cold-rolled strip steel. The framework of each piece is made from seamless tubing, electrically welded The steel furniture takes a piano finish and is grained to simulate hard wood. From the standpoint of finish, steel has a marked advantage over wood—it can stand the high temperatures necessary for the baking of enamel. One feature of steel construction is that the cheapest bedroom suite differs not one iota from the most expensive in strength and durability The weight of the new furniture is twelve per cent greater than that of hardwood.—*The Iron Age*, 112:11, pp. 665-70.

The Production of Paper from Sawgrass has been established on a commercial scale at Leesburg, Florida. Sawgrass is a plant indigenous to shallow lakes, [illegible]

and marshes of Florida, Mississippi and Louisiana. It attains heights of from three to ten feet and yields of from six to twenty tons to the acre Florida has at least a million acres of it. Experiments for the purpose of discovering how to separate the fiber of the plant from the other constituents occupied considerable time and a special process was finally developed This process is somewhat similar to the soda process used in woodpulp manufacture the same mechanical treatment being used but the chemical action being different The result is a pulp which in its unbleached state is similar to Scandinavian kraft pulp but when bleached and refined has some of the properties of linen rag In both states the pulp is very readily handled by standard paper making machines and the fiber is exceptionally strong The giant harvester used for cutting the sawgrass consists of a steel barge mounted on tractor runs which makes it amphibious In front is a sixteen foot mower blade After being cut the grass is carried by an endless belt to choppers which cut it into one or two inch lengths and deliver it by means of air blowers into barges towed astern This machine measures sixty six feet over all and cuts at the rate of twenty tons per hour —*Manufacturers Record* 84 9 pp 77 78

The Australian Canadian Reciprocity Treaty has apparently again fallen through Thrice within the past thirty years Canada has sent members of the Federal Government to Australia for the purpose of negotiating such an agreement. The agreement was on the way to success when Premier Hughes was supplanted by Premier Bruce and the matter has been temporarily pigeonholed although there seems to be some promise of a resumption of the negotiations —*Canadian Mfr* 43 8 p 22

The New Ditmars Rubber Latex Process is the direct production of the finished rubber article without the previous isolation of the rubber from the latex The process consists in the use of a highly porous mold for thin walled rubber articles and in the use of water absorbing materials as compounding agents in rubber articles of appreciable thickness In thin walled articles graduated heat is applied to the latex at the same time as it is poured over the latex mold in order to dehydrate it For massive articles dehydration is effected by incorporating with the latex water absorbing materials such as gypsum or cement by the use of regulated heat by pressing out the water from the mold The porous or biscuit molds which Dr Ditmars uses are highly porous unglazed stoneware These molds are dipped into the latex and then either allowed to dry in the air or steam is introduced to expedite the drying The whole of the water in the latex is absorbed by the mold and the rubber remains adhering to the mold as a thin skin The water absorbed by the mold is driven off by heat before the mold is used for making another rubber article The advantages of the direct preparation of rubber articles from latex are the obviation of the need for plant and machinery to separate and dry the rubber from the latex or to dissolve the rubber or mix it with other materials No structural alteration takes place in the separation of the rubber from the latex hence the products are unique in their strength aging properties and elasticity —*India Rubber Jour* 66 10, pp 1 2

The Paper Industry.—As a result of the increased costs of raw materials paper mills are directing their attention to improvements in processes leading to greater efficiency and economy The yield of mechanical and chemical pulp has been materially increased by the introduction of barking equipment which permits the removal of bark without at the same time removing part of the wood In the chemical cooking processes efforts are now being made to increase yields by improvements in existing methods and by the development of new methods In the manufacture of soda and sulfate pulps it has been found that impregnating wood chips with cooking liquor at a low temperature and then drawing off the liquor and steaming results in a considerable increase in the yield of pulp Experiments with the use of sodium sulfite in place of calcium bisulfite have recently been continued, with very promising results as far as yield and bleaching quality of the product are concerned A higher yield and better quality of fiber, as well as a saving in fuel and chemicals, are claimed by the use of a patented modification of the sulfite method, in which the relief gases and liquor are transferred from one digester to another during the cooking operation. In

some newsprint mills jackpine has been handled without previous extraction by the sulfite process with fairly good results, and investigations are under way to find out if high grade sulfite pulp can be produced from this raw material. The greatest progress in the improvement of existing methods has been accomplished as the result of increased knowledge of the chemistry of wood and the chemistry of the reactions which take place during cooking.—*Industrial and Eng Chemistry*, 15 9, pp. 891-93.

Industrial Motion Pictures are coming back into their own After several years of indifference, chiefly due to unfortunate experiences, manufacturers are again turning to motion pictures. If any industry ever had a deserved check coming to it, it was this one, mushrooming in all directions under the style, "Independent Motion Picture Producers." Anybody with a motion picture camera and a few dollars for film stock could qualify as a "producer" Today they are coming back, but in a chastened and wiser form. The uses for independent motion pictures are almost limitless. A few years ago a few companies used pictures in sales work. Today any number of them send their salesmen out with portable projectors and a picture that actually sells the product. This is particularly true of companies making heavy machinery or intricate mechanical and electrical devices that may be too cumbersome to be easily handled.—*Amer Industries*, 29 2, p. 12.

The Ford Motor Company and the General Motors Corporation, the two outstanding factors in the motor vehicle field, had joint assets on June 30, last, of \$1,161,612,412 Strangely enough, there was a difference of only \$33,000,000 in their assets, in favor of the Ford Company These two companies made in 1922 a trifle more than 63 per cent of all the cars and trucks produced in the United States. Their balance sheets gave, expressed in round numbers, the following Cash, Ford, \$231,000,000, G M C \$56,000,000 Inventory Ford, \$108,000,000 G M. C, \$115,000,000 Real estate, etc., Ford, \$221,000,000, G M C, \$264,000,000 The G M. C capital stock was valued at about \$816,000,000, while that of the Ford Motor Company was valued at only \$17,000,000 This accumulation of wealth in two decades never has been approached in industrial history —*Automotive Industries*, 49 11, pp. 584-85

Coal Distillation by the Moscicki low temperature process is a little known but interesting process. It has a high heat economy and produces an oil that has lubricating properties The Moscicki process consists in heating, or rather reheating, the tail-end part of the gas that is produced in the distillation process to a temperature of about 450 degrees centigrade. Then the gases that are produced by this treatment are used as a heating medium to heat up the mass of coal to a distillation temperature. The essential pieces of apparatus in the installation are a reheater for the gas, a distillation column and a condensing system, the whole being combined with heat exchangers, which economize the quantity of coal and gas that is used in the distillation process. The plant differs in details in accordance to whether the raw fuel is coal, lignite or peat, but the essential elements are the same. The Moscicki process, as used in Poland, is interesting to those plants that wish to produce distillation products from the dry decomposition of coal that are similar in properties to the ones that are obtained by the distillation of peat. It is also interesting to those plants that produce metallurgical coke. By this process there are obtained oils and other products of distillation of high value and, on the other hand, a semi-coke that is mixed with unburnt coal.—*Am. Gas Jour.*, 119 7, pp 129-31

Mechanical Engineering

The Spring Wheel is the subject of a long and interesting illustrated article in the *Automotive Engineer* At the present time the spring wheel is seen mainly through the eyes of numerous inventors. From the drawings and descriptions as contained in their various patent specifications it is possible to derive an impersonal impression of the ideal but as yet non-existent spring wheel. Every road shock represents a certain amount of kinetic energy, which in the ordinary course of events would create in the attached structure stresses which, if they exceeded the elastic limit of the structure, would permanently deform and eventually fracture it. To prevent this from happening, the kinetic energy entering the structure must be converted into some other form, which must comply with the following conditions: It must not adversely affect the structure, the transformation must be accomplished by simple means, and the shock may be converted into another form of kinetic energy such as vibration, compressed air, or into heat. The solution of the spring wheel problem, therefore, resolves itself into a search for substances or structural elements capable of transferring kinetic energy into heat by the help of friction —*The Automotive Engineer*, 13 179, pp. 238-42.

Grooves in Bearings for efficient lubrication is a question which is now regarded as settled by Dr T E. Stanton, director of the National Physical Laboratory, England, and chairman of the Lubricating Committee of the Department of Science and Industrial Research. He states that as a result of his research, using an ungrooved journal and an ungrooved bearing, with castor oil as the lubricant, it was found that steady conditions could be obtained, but that the coefficient of friction was 15 per cent higher than with the grooved surfaces, and that substituting a grooved journal for the plain one did not improve matters. It is clear, therefore, that a system of grooving is essential in order to obtain the minimum friction due to the materials of the surfaces and lubricant employed.—*Am. Machinist*, 50 10, pp. 353-54.

Friction and Carrying Capacity of Ball and Roller Bearings have been tested in a novel manner by the Bureau of Standards in conjunction with the United States Navy, using a 50,000-pound vertical testing machine. In making a static friction test on a ball bearing, two balls were used with a pair of grooved races, in order to secure stability in the loaded condition A plate mounted on two rollers carried the lower ball race, while the upper race was loaded by the testing machine. Between the movable head of the testing machine and the upper ball race a spherical bearing was used When the desired load had been applied the lower ball was drawn forward by a force exerted through the spring balance. The smallest division on the spring balance represented one ounce It was found that the starting friction is nearly the same for the two sizes of grooved ball race that were employed, the groove having the larger radius giving the lower friction value. The ratio of starting friction to load increases slowly as the load increases, then much more rapidly The rapid rise in the friction at greater loads seems to indicate that internal work was being performed on the material of either the balls or races. For reducing the static frictional resistance it is claimed that oil is of little, if any, use upon ball bearings.—*Amer Machinist*, 59 14, pp. 500-01.

The New de Lavaud Process of centrifugally casting iron pipe eliminates the iron flasks and core bars, the sand and clay, and the hay, straw or shredded wood rope used in the old method of casting iron pipe. In the de Lavaud process the pipe is cast in a revolving steel cylindrical mold, the interior surface of which corresponds in every detail with the exterior of the pipe to be cast. Molten iron is poured through a spout extending through the end of the mold, and as the molten iron begins to flow the cylinder develops two motions. One is a revolving motion in which the iron is distributed centrifugally against the inner circumference. The other is a longitudinal movement by which the mold is drawn back, permitting the end of the spout to deliver molten metal along the inner surface of the revolving mold until the spout emerges from the end at which it entered. The centrifugal method insures uniform wall thickness. Therefore it is unnecessary to allow excess metal in order to compensate for variation. The saving in tonnage as a result of the decreased wall thickness is about 25 per cent. Centrifugally cast pipe is said to develop a high tensile strength, and to resist a high interior pressure. The patents on the new method are controlled by a New York company, and companies making cast iron pipe are operating on a royalty basis.—*The Foundry*, 51:18, pp. 727-31.

Metallurgy

X-Rays are already being used to help in making better steel products and to increase our understanding of the structure and properties of steel. X-ray inspection of moderate-sized castings and forgings is now a commercial possibility. X-ray analysis of the crystal structure of steel is at present confined to the research laboratory. It is not

(Continued on page 434)

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Mexican Broadcasting Station.—Broadcasting from a 500-watt station, installed by *El Universal*, a local newspaper, was inaugurated during the latter part of September. It is said that this station can transmit to the southern part of the United States, Central America and Cuba, and it should have an important bearing on the demand for radio receiving sets throughout Mexico.

A Variable Loop in the form of a curtain shade has made its appearance. The loop consists of a roller, a curtain support and the turns of wire placed on the curtain support. When fully open this loop is quite large and serves not only for broadcasting reception but for higher wave lengths. By opening the shade member more or less, any desired inductance can be brought into play for the active loop, thus making for the greatest possible efficiency in a loop receiver. The device is provided with a wall bracket and swivel so that it may be pointed in any desired direction, or placed on any door in the house.

Photoelectric Triodes.—Three-electrode vacuum tubes containing vapor of alloys of alkali metals, having low ionizing potentials and the characteristics of a photoelectric cell, give remarkable results as detectors with 10 volts on the anode, according to the *Proceedings* of the Institute of Radio Engineers. These tubes are at least three times as sensitive as the usual gas content tube and in addition are quite sensitive amplifiers. The photoelectric properties cause this tube to function quite well with zero plate voltage. In this case the source of energy is probably the luminous and non-luminous radiation from the filament.

Automatic S O S Alarm.—The apparatus described in a recent issue of *Radio-électricité* consists of three main portions: an amplifier, a wireless receiving relay, and the S O S selector. The amplifier takes the place of the crystal in the ship's ordinary wireless receiver and magnifier of the received signals, rendering them suitable for operating the receiving relay. The S O S selector itself, which is controlled by the receiving relay, operates on the chain relay system. There are two relays arranged to discriminate between a dot and a dash, then a series of nine relays corresponding to the dots and dashes of the S O S signal. A canceling relay is incorporated, which restores the selector to its ready condition if the correct sequence of dots and dashes is not received, while the intervals between the dots and dashes are checked by a further delay action relay.

Radio Forgery and the MacMillan Expedition.—Since MacMillan, the well-known arctic explorer, went north on his present expedition there have been three instances of radio forgery where some amateur with a radio telephone transmitter has gone on the air and impersonated MacMillan. For instance, the Philadelphia *Public Ledger* recently published an account to the effect that one of the officers of a Philadelphia trust company had, at his summer home in the Pocono Mountains, distinctly heard MacMillan broadcast a message by voice. In truth and in fact, MacMillan has no voice transmitter and uses nothing but code in sending back his messages. MacMillan has been coming through right along with the radio telegraph transmitter used for this present expedition. The American Radio Relay League members are straining every effort to keep in touch with MacMillan, despite the great distances involved.

Knocking Noises and Statical Discharges in Telephones.—The cause of knocking noises in telephones has hitherto been attributed to the membrane buckling or knocking against the pole-pieces of the permanent magnet, according to D. Bähr, a German engineer. That the source of the knocks is not in the diaphragm is shown by removing the diaphragm altogether, when, although speech is but very faintly heard, the knocks are still strongly heard. The cause of the trouble is found to be statical discharges, and reference is made in this connection to three methods by which sounds may be produced without the diaphragm, by electrodynamical actions between the turns of the windings, by the sound given out by iron on being magnetised, and by the condenser action between the telephone and the shell of the ear. The trouble is largely overcome by arranging a connection between the ear and ground of considerably less resistance than that through the body between the ear and the fingers.

Radio-Acoustic Marine Direction Finding.—A description of a means of locating the position of a ship at sea by the emission of a radio "dash" simultaneously with the firing of a small charge in the sea, is contained in the *Proceedings* of the Physical Society. A station on shore records the arrival of the radio signal, and also of the explosion wave at a number of hydrophones suitably disposed in known positions on the sea bed. The times of travel of the explosion wave, and hence the distances from the charge to each hydrophone, are indicated by an Einthoven galvanometer photographic recorder. Although great accuracy is attainable, for navigational purposes it is sacrificed to speed—it being possible to give a ship her location within a radius of half a mile, inside ten minutes from receiving her request for a position. This method has been thoroughly tested under service conditions and has been found absolutely reliable. A 9-oz. charge can be located at a distance of 40 miles. In hydrographical survey work the method has been tested successfully in fixing accurately the positions of certain buoys and light vessels. The possibility of screening and distortion effects produced by sandbanks has also been investigated.

Broadcasting in Shanghai.—Several attempts have been made at Shanghai to establish broadcasting stations, the first being that of the Radio Corporation of China, whose equipment was operated for a short time on the roof of the Robert Dollar Building. A little later the Electric Equipment Company installed a 50-watt set on top of its building, the station being used ostensibly for experimenting and for demonstrating radio sets to its customers. This set is still in service. Broadcasting programs were next offered by the *Evening News*, a local paper, and by the Wing-on Company, a large department store, which recently installed a station, but the right of these to continue has been questioned by the Chinese Ministry of Communications. Development of radio broadcasting in China has been retarded by the fact that the importation of wireless apparatus was prohibited by the Chinese Government. This embargo was based upon an article which states that all "telegraphs and telephones, whether with wire lines or wireless, are called electric communications," and another article states that "electric communications shall be operated by the Government." But so keen is the local interest in radio that radio broadcasting must soon be in full swing on a satisfactory basis.

The Pallophotophone as a "Pick-Up."—The pallophotophone is designed, by means of a beam of light, to convert sound vibrations into corresponding electrical oscillations. This is brought about by causing a variation in volume of a beam of light entering a suitable light-sensitive cell, to correspond to the sound waves produced. The light from a special incandescent lamp is focused by a spherical lens on to a small mirror, and is reflected through a cylindrical lens on to the light cell. When the sound waves enter the mouthpiece the diaphragm and mirror are made to vibrate, causing the reflected light beam to move horizontally to and fro across the opening, thus varying the light entering the cell. This, again, varies the current flowing through a resistance, producing a change of potential which may be applied to the grid of a pliotron and amplified to operate any suitable electrical device. The vibrating element is described in detail in a recent issue of the *Journal* of the A. I. E. E. A movement of the diaphragm of only [illegible] in. is necessary to reproduce satisfactorily speech or music. The moment of inertia is extremely small. The method of recording and reproducing sounds from a photographic film is given, and the paper is illustrated by various diagrams and photographs of the apparatus.

TUSKA RADIO

Your entertainers are ready

Tuska Popular No. 225

2-bulb Regenerative Receiving Set. Piano finish mahogany cabinet. Amplifier switch Concealed binding posts. Armstrong circuit, licensed under Patent No. 1,113,149 Price $75, without bulbs, batteries or loud speaker

Ask for special circular No. 20-D, describing this set.

SINGERS, bands, orchestras, speakers, organists, humorists—an unlimited host of performers are yours to command when you own a Tuska Radio. A simple adjustment of dials, and you can choose between them. Dozens of programs are in the air. Your Tuska will bring in whichever entertainer pleases you best and shut out all others.

Tuska owners are not obliged to tinker incessantly and add devices to correct construction faults. Their pleasure is unmarred by troubles. Every Tuska set is finished with exacting care by painstaking New England workmen—the best that live. Then it is examined and tested on distant signals by inspectors who are keenly critical. Both manufacturing and testing are under the personal direction of C. D. Tuska, a pioneer radio engineer.

For a dozen years before general radio broadcasting began, Tuska-made instruments were famous among radio experimenters for skillful design, superb workmanship and high efficiency. In the past two years the demand for Tuska Radio has grown enormously. Each set in this increased production of to-day is as perfectly built as the finest Tuska instrument ever made—and yet, the prices are remarkably moderate for high-grade radio receivers.

Ask any first-class radio store to show you one of the models of Tuska Radio, priced $35 upward.

THE C. D. TUSKA CO., Hartford, Conn.

Ogden, Utah, receives Troy, N. Y.

"In one evening, using Tuska 225 with one amplifier only, I received 19 stations, including San Francisco; Calgary, Alberta; and Troy, N. Y. Conditions were not abnormal, and the same stations were received again last night.

W. D. GARNER."

TUSKA TRADE MARK REG. U.S. PAT. OFF. RADIO

Picks up Davenport the first time he tunes

"I never had my hands on a set until my Tuska came Saturday. First evening I tuned in Pittsburgh, New York, Richmond, Ind., and Davenport, Iowa. It certainly was great.

WM. PARSONS, Salisbury, Conn."

Scientific American Digest

(Continued from page 430)

unreasonable to believe that the day is coming when the specifications for steel will call for a particular X-ray pattern as well as a particular chemical composition.—*The Iron Age*, 112:13 and 14.

The Sorbitic Treatment for Steel Rails is a kind of heat treatment which permits the production of a wide range of variability in tenacity, ductility and hardness for any one given carbon percentage, rather than by a variation of the percentage itself. While the increase of carbon percentages gives increased hardness, they give reduced ductility and resistance to shock, so that at about 0.70 per cent carbon this limited resistance to shock becomes a serious risk. But the range of physical properties obtained by the sorbitic process is greater than that obtainable by variations in the carbon content. The arrangement of the carbon in the iron which gives the best combination of hardness and toughness makes a mineral called sorbite—that is, sorbitic steel. The rails are taken as they come from the mill at a temperature above the critical range and cooled through such a range of temperature and at such speed as shall arrest and hold the crystalline structure at the exact point at which the sorbitic structure of the carbon and iron is attained. This treatment has been given to guns and other special forgings for years, but the treatment of large numbers of steel rails becomes a far larger and more difficult problem.—*Railway Engineer*, 44:524, p. 344.

Dirty Limestone having caused complaint from blast furnace operators, a plant has been installed for cleaning the stone. With a current of water, the stone enters a scrubber which is a revolving cylinder thirty feet long and five feet in diameter, driven by a motor. On the inside of the scrubber is a series of fins riveted to the casing for the purpose of forcing the stone forward to the discharge end of the scrubber. The revolving action of the cylinder, throwing stone against stone, tumbling over and over, and being forced forward, puts all particles of dirt into suspension in the water, and the latter is washed away.—*Iron Age*, 112:12, p. 736.

Zirconium in Steel is the subject of a paper by Alex. L. Field, New York research metallurgist, which is reviewed in *The Iron Age*. It is shown that zirconium combines chemically with oxygen, nitrogen and sulfur, in the order given, and is able to neutralize the embrittling effect of phosphorus in whole or in part. A relatively small addition of zirconium makes possible the satisfactory rolling of steels containing as high as approximately 0.30 per cent sulfur, which without zirconium treatment break to pieces on the first pass through the rolls. Plain carbon steels treated with approximately 0.15 per cent zirconium exhibit in the heat-treated condition tensile properties that closely approach those of alloy steels, especially in that range of drawing temperatures between 300° and 450° centigrade. Zirconium reduces the total oxygen content of steel and operates to prevent the occurrence of emulsified slag and "banded" structure. Zirconium combines with the nitrogen dissolved in molten steel to form a crystalline micro-constituent of a bright, lemon-yellow hue, which is in large part removed from the steel while the latter is still molten. Zirconium forms, with the sulfur content of steel, an acid insoluble sulfide and eliminates from high-sulfur steels the last traces of iron sulfide.—*The Iron Age*, 112:10, pp. 607-08.

Electric Welding of Cast Iron was solved in France in 1920. Gray iron electrodes are used, which carry a high percentage of silicon. Though, of course, both this and the added carbon burn out during the melting, there is sufficient in the original composition and the added carbon adequately to compensate for the loss. A proper weld is established because the cast iron remains liquid for a sufficient length of time, and during this period there is a thorough mixing taking place, due, no doubt, to gas expulsion. The carbon, added as either graphite or charcoal, quite easily dissolves in the pool of metal because of this "boiling action," and the weld, on cooling, consists of gray iron. To control the carbon in the liquid weld metal, the cast iron electrode is encased in a mixture containing a high percentage of graphite or charcoal of suitable thickness, either by grooving the rods or making them hollow for that purpose. Or carbon can be added mechanically, always bearing in mind that the quantity must be sufficient to replace that burnt out by the arc. The grain of the deposited iron is of

a finer character than ordinary cast iron Neither blowholes nor hard spots have been found in the weld The parts to be joined must be heated sufficiently to prevent the first deposited metal from freezing too rapidly and to allow the carbon time to dissolve At least 600° centigrade should be attained to start.—*Foundry Trade Jour* 28 366 p 151

Metals Produced in the Electric Furnace have, for different reasons, been considered to have some properties superior to those produced by other methods Research and discussion in this direction suggest that we shall find results which will enable us to control and improve a metal for more pronounced mechanical effects due to a knowledge of the electrical and magnetic phenomena The nature of this control is based on the assumption that molecular structure and crystal growth are a bonding due to electro magnetic values The regulator of the electric current used being an easy matter it appears that radical improvements in electric furnace metals may be expected from the development of molecular electrical effects in the molten state —*Canadian Chem and Metallurgy* 7 8 p 196

Stainless Steel was discovered by Mr Harry Brearley in the course of research into the cause and cure of erosion of the bore of large guns The discovery had just been launched on a manufacturing basis when the war broke out and during the war all available supplies of stainless steel were taken up by the fighting services very largely for aero engine valves With the notable exception of its application to cutlery very few engineers are aware of its great value as an engineering material Statements made to the effect that it is difficult to machine unsuitable for highly stressed articles unreliable as regards its stainless and rustless properties and prohibitive in price need not be taken to seriously as it has invariably been found out that when all the facts respecting the prospective use of the material have been placed before the steel manufacturer and the steel supplied has been treated in strict accordance with his instructions the results have been perfectly satisfactory The rustless and stainless properties of the steel are to a certain extent disturbed by rough machining and it is always advisable to finish with a fine cut or better still by grinding Pickling is employed for the removal of the scale after heat treatment being preferable to sand blasting —*Foundry Trade Jour* 28 365 pp 181 85

Trend of Research in the Non Ferrous Metal Industry—The amount of engineering and scientific thought now applied to these industries is probably fifty times as great as in 1900 and ten times as great as in 1912 A recent survey revealed the fact that over sixty manufacturers within the non ferrous industries maintained research departments and laboratories in 1920 The use of pyrometers is increasing rapidly in all branches as well as that of testing instruments of all sorts—particularly the microscope Well defined standards for products are also rapidly making headway stimulated by the splendid work of the American Society for Testing Materials and the U S Bureau of Standards Another indication of the new research spirit is the increasing willingness and even desire on the part of individual companies to exchange information with others and to undertake cooperative research work —*Industrial and Eng Chem* 15 9 pp 895 97

Mining

The Soft Coal Lost in Mining equals more than one third of the total according to the United States Coal Commission The principal causes of these losses are due to coal left on the roof and bottom coal lost in pillars coal lost under buildings railroads and boundaries coal lost in preparation and handling and by minor causes Of these losses about 40 per cent is unavoidable but nearly 60 per cent is considered as avoidable The specific causes for these avoidable losses include improper methods of mining and careless engineering careless cleaning of the coal in the mines or at the tipple losses due to excessive blasting poor methods of transportation including cars that spill coal One large cause of loss is due to leaving pillars to keep the surface intact where back filling methods might be employed The greatest loss in mining is in room entry and panel pillars this loss varying from 5 to 45 per cent of which from 3 to 36 per cent is avoidable Sometimes pillar-drawing is done more or less carelessly, and stumps containing from 30 to 100 tons are left untouched —*Report of U S Coal Com* Sept 1923

The Automatic Centrifugal Pumping Outfit no doubt will revolutionize mine pumping In the bituminous coal field it is asserted that an average of about two tons of water is pumped from the mines per ton of coal mined, while in the anthracite field the ratio is about eleven tons to one; in some places the figures run as high as fifty to one The idea of developing an automatic centrifugal pumping outfit was first suggested in May, 1923, and tried out with success in June of the same year Since that date many automatic centrifugal pumping outfits have been laid out and ordered and some are already in operation The new system makes possible remote control of the pumps, reduces labor costs for pump operation, simplifies keeping a mine dry during temporary idleness, and in the event of strikes makes possible the operation of a large number of pumps with only a small amount of occasional inspection —*Coal Age*, 24 11, p. 393

Excessive Underground Temperatures in the mines of Butte, Montana, the world's largest mining camp, have been reduced, in some instances, as much as 10 to 15 degrees, through the application of scientific ventilation methods, according to Bulletin 204 issued by the Bureau of Mines which describes the investigations of two scientists of the Department of the Interior Lower mine workings with rock temperatures of more than 100 degrees previously unworkable have been converted into comfortable working places Butte mining companies now believe that in case their ore bodies reach to a depth of 5000 feet or over, with rock temperature of 115 to 120 degrees, they will be able to obtain for such deep workings an atmosphere which will allow safe, comfortable and efficient work The mining companies of the Butte district have recently made great progress in ventilation betterments. The dust situation has been largely eliminated by the adoption of wet drills for practically all drilling by the introduction of water lines for sprinkling to practically all working faces in many mines and by increasing the flow of air to working places —*The Am Zinc, Lead and Copper Jour* 18 5 pp 3-4

Carbon Monoxide in Mines, most insidious and deadly of poisonous gases may be detected and means have been found by which it is possible to discover within three minutes the extent to which a person has been affected by carbon monoxide gas through the extent of poison saturation of the blood Formerly it took approximately from 24 to 48 hours before diagnosis could be made of such cases either in hospitals or in well equipped laboratories with the services of a well skilled organic chemist The test is effected through a simple and inexpensive instrument which may be carried in the pocket and which requires no special training for its operation Many human lives are expected to be saved by the general adoption of this method of detecting gas poisoning particularly in the mining industry as well as in other fields where dreaded gases are a menace With this quick method of diagnosis it is possible to institute promptly the proper emergency treatment. Because of the possible exposure of citizens in all walks of life to its deadly influence the new instrument for detecting it in the blood is expected to be in universal use among the physicians within the near future —*The Am Zinc, Lead and Copper Jour*, 18 5, p. 9

Two Important Developments have recently been made in rendering the concentrates from the froth flotation system of coal washing more suitable for industrial purposes. These concentrates are finely divided coal particles mixed with a large quantity of water and the concentrates must be separated from the water with which they are originally in such close association The first method consists in agitating the pulp and aerating it. Oil or tar is added to coat the particles and make them flocculate together, after which they are separated from the water by draining or filtration, without being compressed into blocks or briquets. In the second process the pulp of coal and water is agitated with a binding agent consisting of pitch which contains naphthalene or phenanthrene so as to coat and flocculate the particles as in the first method On introducing the pulp into a press and subjecting it to a pressure of two tons per square inch, an excellent briquet is produced, substantially free from moisture. The briquets are hard and durable, and become harder with time, and it is also found that the naphthalene volatilizes out of them.—*Coal Age*, 24 8, pp. 277-78.

With Fire and Fraud

(Continued from page 383)

quickly bringing about a conflagration in which the innocent cat was herself destroyed It is pleasant to relate that Schwartz and his son were both sent to prison for long terms. But other times, other cats and other trainers.

It is manifestly impossible to make a list of all the mechanical and other devices used for producing profitable fires. Had the various insurance companies the credit associations or the police kept collections of all such instruments and mechanisms there would be material for a museum The Bureau of Combustibles in the New York Police Department must alone have had enough specimens to fill a great gallery

Criminals sooner or later come to realise the frailty of mechanical attack. Society has too many weapons for defense too many officers for detection too many inventors at work. Naturally the cleverest lawbreaker turns wherever he can to some scheme some mental fabrication to take the place of a machine. Accordingly the arson professionals have developed a technique of fire setting that may be understood from the story of Mr Hyman Marks general merchant and adventurer in blazes

A year ago Mr Marks opened a drygoods and notions store at Blank, Wyo He also opened communication with eastern jobbers told them what an honest man he was, promised payments at a stated time and enclosed in each letter an order for goods Many of the credit men of the firms addressed were eager to capture a little new business and took their chances seeing that the new man's requisition was small Ergo Mr Marks got a good deal of merchandise on credit To do him all honor he paid for it at the end of thirty days and enclosed with his check a somewhat larger order which the jobber again filled in each case Marks had established himself as honest and good pay

When time came for the second payment it too was made promptly and a third and still larger order was sent along with the remittance. I suppose I need not go further into the details of this ancient method of working up a credit.

Marks added a thrill to the old game by opening a second store at Where Wyo He informed all of his jobbers of this move saying that business was good but that he would improve it by opening a second outlet to reach a new body of buyers However he intended to do all buying through his first and main store So saying he enclosed a very large order The jobbers saw what Marks had written set him down as an intelligent and progressive man—and sent him the goods

Now the fun began Marks took the merchandise out of the cases at his main store in Blank repacked the cases with oil soaked excelsior and large stones and shipped these fakes to his place in Where At the same time he made a display of real merchandise and the stuffed cases at Where and took out $15 000 worth of fire insurance As soon as the policy had been written and the premium paid the thing was ready to revolve.

Marks shipped back to his Blank store whatever valuable stuff there had been at Where. Then he secretly stripped the store at Blank by removing his goods a little at a time and secreting them in Denver Just before Christmas, both stores were practically empty except for odds and ends of poor stuff and a great many cases and empty boxes.

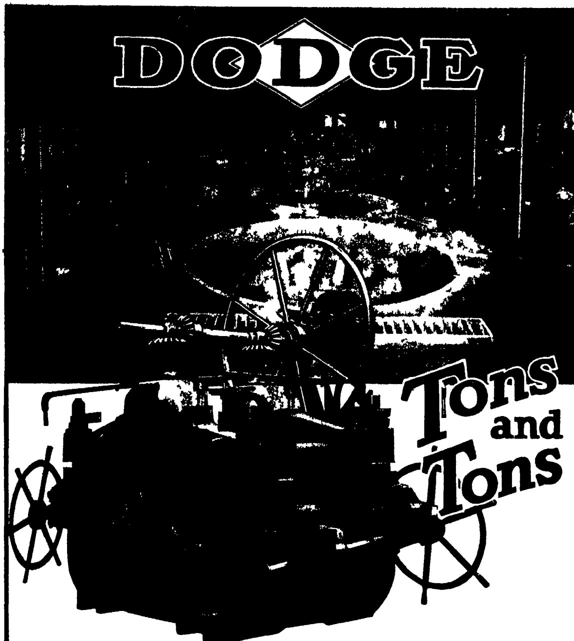
On a bitter winter night when it was certain the firemen could work only with the greatest difficulty the store at Where burst suddenly into flame and was burnt to an ash heap before the fire fighters could get into action Indeed they had all they could do to keep the blaze from spreading and congratulated themselves on saving their town

While this was happening Mr Marks was of course in Blank. He collected his insurance, wept over the fact that it was not half enough to cover his loss, fixed the books at the Blank store to show the disbursement of the insurance money to relatives and friends who had lent him cash on notes and then closed the doors of this shop as well His creditors swooped down on him but could find neither goods nor any fault in his lamentable story

Then Mr Marks disappeared

Two weeks later a suave and well dressed fellow rented a store in one of the principal business streets of Denver gave his name as Simon Fox and prepared to open in dry

(Continued on page 441)



Meeting the Special Demands of Industry

The methods for transmitting power in the various industries are essentially the same but the situations to be accommodated are in many cases decidedly intricate and demand special engineering treatment and equipment of special design and unusually heavy construction

These unusual conditions led to the development of the American or continuous wrap system of Rope Driving whereby power could be economically transmitted under conditions far beyond the range of belting practice This system of transmission developed in the plant of the Dodge Manufacturing Corporation of Mishawaka Indiana has been adopted by paper mills rolling mills sugar mills textile mills etc all over the world

The conversion of main belt fly wheels into rope sheaves by means of a hardwood lagging bolted to the face of the wheel is another forward step By using this method of converting a belt fly wheel into a rope sheave or increasing the diameter or face width a considerable part of the cost of a new wheel is saved Many of these hardwood laggings have been installed by the Dodge Manufacturing Corporation in whose plant it originated

The manufacture of rope drives which required sheave wheels often as large as twenty four feet in diameter and weighing up to 100 tons requires unusual foundry and machine shop facilities as well as skilled and experienced labor The Dodge foundry is the largest in the world devoted to the manufacture of power transmitting equipment

In addition to the power transmitting appliances ranging from the smallest drop hangers pulleys etc to the large fly wheels mentioned above a large tonnage of special equipment such as piercing mills evaporators plate glass polishing tables complete elevating and conveying installations water wheel harness, etc are designed and manufactured by the Dodge Manufacturing Corporation

A large and well equipped steel fabricating shop is also devoted to the manufacture of special equipment to specifications.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Uses of Manjak.—Manjak is a substance which is obtained in the island of Trinidad, and in but few other places on the earth. It is a mineral substance and has a number of uses which are rather interesting. In the first place, a lubricant is manufactured from it. Thread grease for pipes and for use in rotary drilling, making absolutely tight connections against grit, water and mud under high pressure, is made from it, as well as a lubricant for gear cases, sprocket wheels and roller bearings. If the manjak is too heavy, it can be cut with kerosene. A hard flux is also made from it. It protects surface and underground piping or casing against corrosion and hydrolysis. It can be used as a roofing material and for sealing up leaks in tanks and for caulking seams. It saves condensation on steam lines and boilers. It prevents pitting. To protect pipes or casing, the flux is liquefied by heating and, as it cools off, an equal measure of kerosene or crude oil is added. The flux is applied by brushing, dipping or spraying. A jet black paint is also made from the manjak gum. This paint dries quickly, giving a tough, unbreakable covering to protect hot and cold surfaces, smokestacks, undersides of motor cars, etc. It may be used as an anticorrosive paint for ship bottoms. This paint is prepared ready for use. The paint is cut with a little gasoline or white spirits. The paint can be applied easily and does not drag on the brush.

Arsenical Fungicides.—A study has been made of various arsenical fungicide and insecticide preparations on the market with a view to determining the relation between chemical composition and the effectiveness of the insecticide. It was proven that there is no general relationship between the chemical constituents of the insecticide and the toxicity of the insecticide. It is always necessary to carry out both a chemical and a toxic investigation of the insecticidal or germicidal preparations. See U. S. Dept. of Agriculture, Bulletin No. 1147, for further details.

Transparent Artificial Horn From Casein.—The ordinary products that are made from casein are opaque and cloudy even when dry. This milky appearance of the casein compositions limits their use. A new process has been developed in which the casein compositions are made in transparent form. The casein or casein solution is mixed with an aqueous solution of basic salts of phosphoric acid, boric acid or sulfurous acid. These solutions are in such concentrations that the precipitation of the materials causing the cloudiness takes place. The liquor is separated from the precipitate and worked up in the usual manner. Ammonia, alkali or alkaline earth hydroxides can be added to the precipitating salts to good advantage. The precipitated products can also be used for making compositions. For further details see Kunstoffe, 1923.

Furfural as a Paint Remover.—Furfural is the aldehyde of furfuran and is obtained from the processing of corn cobs. The corn cobs and water are placed in an autoclave and steam at about 135 pounds pressure is admitted and the mixture is permitted to digest for about two hours, after which the furfural is blown off by steam, condensed and collected. The furfural is then separated from the water by distillation. The yield is about 120 pounds of furfural from one ton of corn cobs, or approximately six per cent. Furfural has an agreeable odor and boils at a temperature above 100 degrees C. Its boiling point is the same as that of turpentine. This makes furfural a much less dangerous substance than some of the solvents that are used in paint and varnish removers. It also obviates the necessity of weighting the solvent with wax, as it evaporates slowly enough to do its work thoroughly. Furthermore, it does not injure the surface underneath. When smeared over a surface it evaporates after a while, but it shows a tendency to form drops. This disadvantage may be removed by the addition of 20 per cent of solvent naphtha. By the addition of wood oil the viscosity of the furfural is increased. See reports published by the United States Paint Manufacturers' Association.

New Process of Glass Melting.—According to a report delivered to the London meeting of the Society of Glass Technology, a new glass-melting process has been devised which, it is claimed, is easy to operate and cheaper than those in common use. The finely pulverised glass mass, which is fine enough to pass through a 60-mesh screen, is placed in a cyclone tank, into which the heating gases are introduced. The glass particles swirl around and move towards the walls of the tank and when they come in contact therewith they are melted at a most rapid rate.

Cantharidin From American Beetle.—Cantharidin, an important drug which up to the present time has been obtained mainly from the Spanish fly, has been successfully prepared from an American beetle. This species of beetle is found in large quantities in Texas, Kansas and the adjoining states. The Bureau of Chemistry has recently made an investigation into this matter and has found that the American beetle contains from 0.6 to one per cent of the active principle, cantharidin, and from four to five per cent of cantharidin salts. The eggs were found to contain large amounts, the heads very small amounts and the wings no cantharidin at all. This proves that the American beetle contains more of the drug than the Spanish or Russian fly.

Pure Glycerine.—Austrian Patent No. 88,188 is concerned with a process for the manufacture of pure glycerine. Liquids which contain glycerine are treated with lead compounds, such as lead oxide or lead hydroxide. The result is that the lead is precipitated in the form of lead glyceride. This compound is then heated with water under pressure or with the addition of alkali. A pure glycerine is obtained in this manner.

Desiccating Copra.—The *Oil, Paint and Drug Reporter* recently published a description of a new and simple process of desiccating copra with the aid of sulfur, a process which is being practiced in the Philippines. Copra is dried coconut and is shipped to this and other countries in a desiccated condition. It is then used for the extraction of the oil, coconut oil. As copra is apt to decompose during shipments, this treatment with the fumes of burning sulfur is a great improvement in the method of handling this product. About five kilograms of sulfur are used for every 1000 kilograms of the nuts. There are many advantages which are claimed for this process. The copra is preserved and bleached by the sulfurous vapors. The product is very white. There is no loss of oil in the process of sulfuring and desiccation. It is also claimed that this process makes it possible to obtain a very uniform product, that a greater yield of copra is obtained from a given weight of the nuts than by any other process, that the copra keeps better, is cleaner and that the oil that is extracted from this sort of copra is practically colorless, free from rancidity and of a quality comparable with that of the best oils manufactured. There are two disadvantages—the cost of the sulfur and the longer time spent in the desiccation of the copra. The increase in cost due to the sulfur is very small and is probably more than counterbalanced by the additional yield of oil obtained from the copra. The increased time of desiccation is compensated for by the superior grade of coconut oil that is obtained from the copra treated in this manner.

New Book-Covering Material.—A new book covering material which is superior to most materials that are used for this purpose is described in the *World Paper Trade Review*, June 1, 1923. The basis of the new material is a discovery made in connection with rubber technology, whereby it was found that by exposing rubber alternately to the action of two gases for about one-quarter of an hour it was vulcanised in the cold. The book-covering material is made with the aid of various waste materials, such as leather buffings and shavings ground up, sawdust, cork dust and shoddy, all of which

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Service of the Chemist

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are mixed intimately with the rubber. A plastic solution is formed in this manner which can be worked with aniline dyestuffs into any color and form. The result is said to be more durable than leather, capable of much more diversified treatment and much cheaper.

New Tests for Fibers.—An interesting article published in the *Textile World*, Aug. 18, 1923, deals with a method of testing fibers to tell the difference between flax and hemp in the woven cloth or fabric. Various microscopic tests have been employed, but these are quite difficult to carry out. A much simpler method has been developed of telling the two fibers apart. If a single wet fiber is held with the free end toward one, flax and ramie will twist in the clockwise direction while drying, but hemp and jute will twist in the opposite direction No special apparatus is required and a few fibers carefully selected to represent the whole will give the indication. The new test will work with fibers in any stage, freshly retted straw, scutched flax, green or bleached yarns, or even beetled and finished cloth. For convenient working the sample is put into water and the fibers are separated as nearly as possible to actual single fibers. On removing one at a time for observation there may be a slight twist due to wetting, but almost at once there is a greater opposite twist due to drying The latter is the desired indication

Zinc Chalk Pigment.—French Patent No. 546,646 is concerned with a new white pigment which is claimed as a substitute for white lead, with superior properties. The new pigment is produced by working together first 25 kilograms of carbonate of lime (chalk), two kilograms of potassium alum and two to three kilograms of gelatine or similar material, with three liters of water Then there are quickly added 100 grams of an alkali, 20 kilograms of linseed oil and 47 kilograms of zinc oxide. The mass is kneaded for half an hour The paint is said to possess anti rust properties superior to those of red lead.

Tannins from Coumarone Resin.—The salts of coumarone resins are being used as tannin materials, and a process for making these salts is described in British Patent No 178,757 The process consists of making colloidal solutions of the iron, chromium or aluminum salts of the resin by treating the aqueous solutions of the sulfonic acid with an oxide, hydroxide or carbonate of the aforementioned metals. The sulfonic acid is made by treating the resin with four times its weight of fuming sulfate acid.

High Heels Rot Pavement.—Paris pavements are very largely of wood and deteriorate very rapidly When the cause was sought by the city engineers, it was found that the heels of women's shoes were largely responsible The feminine shoe heels are so narrow at the base as to be almost points, and these penetrate the wood, punching holes in which the water settles, thus rotting the paving.

Grass Towels in Petrograd.—Bundles of dried grass and flax are sold in the streets near the public bath houses, to be used as towels by the bathers. They cost but a penny or so, and are thrown away after use. Foreigners take their own towels, for while the grass serves its purpose well enough it is found to be too ticklish for their tender skins.

Musk Trade of China.—The Chinese musk export trade is practically controlled by four large firms in Shanghai, Tachingiu, the principal point of collection, and Chungking, the chief port of original export of this commodity There are, however, writes the United States Vice-Consul at Chungking, numerous minor firms engaged in supplying the local demand. In spite of the unsettled political conditions along the Szechwan-Tibetan border, the export of musk from Chungking has increased somewhat since the close of the late war, amounting in 1920 to about 3600 pounds, valued at 577,079 haikwan taels (about $700,000).

Keeping Attar of Rose Pure.—Much of the attar of rose comes from Bulgaria and the sophistication of the perfume since the war has given deep concern to the government, which has offered 1,000,000 levas (we do not know how much this represents in real money) for prizes for a process to discover adulterants. Essence of geranium has been used to debase the perfume. This has proved very detrimental to the trade. It has not only weakened confidence but has a disastrous effect on prices as well.

With Fire and Fraud

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goods and notions Once more the credit building game was worked till Mr Poor owed easy going eastern jobbers $81 000 He closed his shop and offered a settlement of about 10 per cent

But the limit of tolerance had been reached Investigators were put to work. One of them got the confidence of a jealous relative of the desolated Poor and caught the information that Poor had once been in Blank and Where Wyo The investigator sniffed the mountain air with cold suspicion and rushed off to Wyoming where he soon found that Marks and Poor were one and identical He said nothing and returned to Denver in what seemed dejection But a few nights later he appeared at the residence of Mr Poor with a search warrant, procured under the pretext that Poor was suspected of bootlegging A barricade of the stairs leading to the garret was smashed and there was found safe and clean all the goods from the Denver failure and some from Blank and Where

Just after the anniversary of Bethlehem is by the way the favored season for profitable jobs by fire The holiday selling is over The best goods have been turned to cash The shelves are decked with empty boxes A little fixing of the books a little gasoline and a nice little arson bomb! It is the crooked merchant's pleasant manner of sending his Christmas greetings to his creditor and his insurer

Perhaps O patient and magnanimous reader! as you sit with a roving eye upon these pages in the gusty nights of December some such Yule fires will be burning in your town

Another Mediumistic Failure

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brought into view in the most casual manner I felt confident at this moment that the thing was accomplished

Dr Prince's confidence was such that as the circle shifted he whispered to Mr Ingalls that we should have results within a few minutes It is to be remembered that the conjurer is not bluffing when he tells us that the hand is quicker than the eye It really is Another performer or a skilled observer watching the sleight of hand artist at work will not actually see him do his stuff but he will usually see how and when he does it by recognizing the necessary false moves and the necessary opportunities This is what Dr Prince saw and it is all that any observer could hope to see if the performer were a competent one

The medium has a good dramatic sense She now withdrew to the stone table in the rear of the garden and reclining on this for a moment she surveyed the audience speculatively Even at the moment her attitude impressed several sitters as one of confidence She returned to the work table and called the entire company close about her for a supreme effort She had Dr Carrington place a hand at the back of her neck and she grasped Mrs Kirby's hand with her own left across the table Using Dr Prince as battery for the first time in any sitting she went through a series of mild convulsions fell back toward her chair (but missing it, so that she had to be caught and placed in it), and moaned Look at the cards! Look at the cards!

Sure enough three cards were found written upon The announcement to this effect caused a huge sensation and all the sitters surged about the table The medium could have substituted anew any further cards which she might have had at hand while this furore was going on without the least probability of detection In fact after an exact repetition of the previous procedure as regards hands and convulsions two further cards were found A third attempt was about to be made when the medium gave a little shudder and announced a clairaudient message from Effie to the effect that no further cards would be written today To those unfamiliar with the term this means that Effie spoke to the medium who can hear her though nobody else can It signifies an abnormal auditory impression analogous to the abnormal visual one implied by the word clairvoyant. Effie's verdict was accepted without question though I fear she is not altogether reliable at the hotel after this Bayside sitting she came to Mrs. Y and told her she was going to win our award

The most serious criticism that can be offered of the medium, on general grounds and apart from the direct and indirect evi

dence adduced above, is that of inconsistency I have already given one instance of this in her inability to stick to one story about the location of the writings in the pack. Equally unsatisfactory was the matter of "soft" colors. We could get no more intelligible statement than this. She was certain that yellow was not "soft," but in the next breath indicated that the real objection to it was that a message written in it would not be sufficiently legible. This, by the way, is correct, the philatelist finds it often impossible to distinguish between two minor varieties of a yellow or even of an orange stamp. On the basis of the sittings, it would appear that "soft" means "red"; flowers of any other tone were ignored by the medium whenever possible. A test which she applied at the first sitting only was to crush the petal, and note whether a stain remained on her finger; if it did, the color was satisfactory

The medium was a tremendous talker She had several anecdotes which she told repeatedly, and at every opportunity, in season and out, she told us at length of the wonderful things she had done at other times and places. This, by the way, was such a marked feature of our sittings of last May, with "Mr X," that at the time we coined a phrase, "when we weren't looking," to define the conditions under which these marvels were produced. Mrs. Y, incidentally, is acquainted with Mr X and did what she could to make us wonder whether we had not made a mistake in his case Of no bearing on her own case prior to our verdict, I think this is significant in retrospect.

The medium's fluent conversation, in itself, would perhaps not have been objection able, she must do something, if she be genuine, to "get out of herself" and to destroy self-consciousness. But the manner of her talking was very objectionable. Again and again, when Dr Prince, Dr Carrington, Mr Lescarboura or I was watching her hands or engaged in some other definite bit of observation, she would deliberately address her next remark to this observer, in such a way that his every instinct was to transfer his gaze to her face for the purpose of the con versation This looked altogether too much like a trick.

The judgment of one inclined to accept the mediumship, *a priori*, as genuine would have been that the three initial failures were due to the lady's inability to relax mentally and get out of herself Her mind was extremely active, and she led the conversation rather than following it or letting it run its course unhindered. Often Dr Carrington pointed this out to her, in response to her complaint that she couldn't relax, couldn't forget herself. She remarked the general tenseness of the atmosphere—a complaint that was probably justified the first day, but hardly on later occasions. On the other side of the picture the sitters were unanimous, after the second and third sittings, that Mrs. Y's whole attitude had been extremely perfunctory—that of one who has no slightest expectation of getting results. This was not noted at the first seance—perhaps because the necessity for getting away with some of the cards kept her interested At a fifth, and unsuccessful, sitting held in our offices again on the 18th, her lack of interest and her evident knowledge that nothing was to happen were flagrant.

Mrs. Y has, at home, an extraordinary collection of documents attesting the faith in her genuineness felt by the signers She brought a portfolio of these with her, and, in spite of our explanation that it hadn't the slightest bearing on our consideration of her case, insisted upon leaving it with us and upon our reading its contents. Equally, and against the same remonstrance, she insisted upon telling us about several occasions on which she had been charged with fraud, and explaining these charges away In particular, the national organization of Spiritualists has repudiated her, bringing exactly the same accusation that we bring, and she used up a lot of time informing us of this, and giving her version of the affair There was also an extended narrative of some harrowing experiences which she had had at the hands of a committee of magicians, which she insisted upon giving us twice, in great detail.

As we went along, Mrs. Y devoted more and more of her patter to expressing her appreciation of the eminently courteous and proper treatment which she was getting at our hands. We, of course, went out of our way to make this statement line up with the facts. We met the lady once after our examination of the Bayside results had been completed. She was extraordinarily well pleased with herself and with us, she had been

among those who didn't know exactly what "prima facie" means, and she was mentally spending our $2500. She gave me a most enthusiastic testimonial as a gentleman. I believe she has since reversed herself on this count.

From her advance statements one gets the impression that Mrs. Y's procedure is quite fixed. Once in the seance room, one learns differently. She uses the flowers always, as advertised, but she does not confine herself to them. She wears a vast collection of jewelry, and more often than not she places some of this among the cards—an enormous yellow bracelet being her favorite for such use. Under these circumstances, she says, the writings are apt to come in gold or silver, and she states that once, when the cards were laid momentarily on a mahogany table, they came in a mahogany tone. She is always careful to make the reservation that she is talking about the color alone, that she doesn't know what the writings really are.

This interpolation of the jewelry into the case is, of course, highly objectionable, since it relieves the medium of all necessity of knowing, or guessing, or forcing, the decision as to the color of the flowers to be used. Another unadvertised deviation has to do with her manipulation of the cards. Though she uses a "battery" more often than not, she often omits this feature, and she does many unorthodox things with the cards. She puts them to her own head, she parades about the room with cards in her right hand and her left extended ostentatiously, she sits at her table and fingers the cards and turns them over and fairly plays solitaire with them. Often she asked us to examine them for writing when they had been subject to no treatment which a rational psychic believer would regard as likely to produce writing upon them. At Bayside she threw a dozen or so cards into the nasturtium bed and insisted that they stay there till the end of the sitting, to see what they might develop. Twice she brought a blindfold with her and had us use it on her for a short time, on the allegation that it might help her to lose herself.

Of the three really distinct messages which we received, and two of which we illustrate, two are in "gold" and one in a red which is an extremely poor match for the nasturtiums and phlox in use at the moment. More for the general interest of the thing than for any direct bearing it could have after our positive proof of substitution we examined these cards under the microscope with the assistance of Mr. L. R. Seidell of the New York Testing Laboratories. Mr. David N. Carvalho, the handwriting expert, had already examined them under a ten power glass, and had noted that under this glass the fiber of the cards showed no disturbance where it was overlaid by the lines of the writing. On this ground he suggested that the writing might have been done by a transfer process—gelatine or otherwise. High power magnification bore out the observation, but disposed of the inference. The fiber of the cards is not in the least bit disturbed or marked, and most certainly no pen or other hard substance has ever been drawn across them. But the surface shows no trace of gelatine or other transfer substance, so that apparently the words were written or drawn with a soft instrument that would leave no mark. This, of course, means a brush.

Two very different inks were used. Even under a magnification of close to a thousand diameters, the red lines show up as a deposit of fluid substance, perhaps even colloidal. Mr. Carvalho points out that this ink blurs where two strokes cross, a sure sign that it was fluid. The gold, however, under as low a power as twenty, shows distinct and beautiful metallic crystals. These, so far as visual examination can determine, seem to be actually gold rather than bronze or brass. An extremely interesting observation is that here and there, on the red card, one finds isolated crystals of the gold. The gold message was obviously written first, and then the red one with the same brush, imperfectly cleaned. The extreme delicacy of psychic investigation is well illustrated here. In the absence of positive proof that the cards had been substituted, the average psychic believer would regard this microscopic evidence as distinctly indicative of supernormal deposition of the lines of writing!

Two of the cards which we do not illustrate contain gold writing, underlying a leaf pattern in green. One message can be fairly easily made out: "Truth crushed to earth shall rise again," with no signature. The other card, with more difficulty, can be seen to carry the signature "William T. Stead."

without any message. The leaf pattern on both is quite foreign to the leaves of nasturtium, phlox or aster, the only flowers in use on this day, and the microscope makes it look very much as though brushed on, like the writings.

The fifth card, a picture of which is crowded out, carries in gold a message from Effie, with her signature: "We who love you are doing all we can to establish this truth." This, I think, makes it fair to criticise the messages, *per se*. In telling of the wonderful things which she does "when we aren't looking," the medium gave us to understand that her messages were usually evidential, that they applied to people in the audience often strangers to her, that they were recognized by these people, that the names and sometimes the very signatures of the communicators were verified, etc., etc. Nothing like this, it will be noted, occurred in our presence. All five of our messages were platitudinous atrocities of the worst sort. There is nothing whatever in these texts to contradict the assumption that they were prepared in advance.

To the Geuth message a bit of romance adheres. One of the medium's affidavits carries this name. The signer lived in Brooklyn when Mrs. Y knew him, and she informed us that she planned to look him up. When the card came bearing his signature, there was much speculation. Mrs. Y called his residence that evening, according to her statement of next morning, and was informed that he had died several months previously We were inclined to question the sequence of these incidents.

The medium has made several public or semi public statements since returning to her home, and in the eye of one who knows all the facts of the sittings and of our dealings with Mrs. Y, these statements suffer severely Just as an instance, she is quoted as having told her congregation that, on arrival at our office for the first sitting, she was led into the presence of fifteen men smoking cigars, and forced to go through the seance in an atmosphere laden with this smoke. The slender basis of fact for this yarn is that, while the group was gathering for the seance, one gentleman was smoking a cigar Mrs. Y asked me to stop him, and I did, after which, the commencement of the sitting was delayed for twenty minutes or more, with the windows wide open for ventilation throughout this interval. She also seeks to make capital of the claim that she was "forced," by us, to undergo denudation and examination by a group of strange women. The fact, of course, is that we searched her only when she insisted, and should not have searched her at all had she not insisted. She would do better to stick to facts.

One more point, of some delicacy, must be touched upon In numerous other instances, investigators who have brought evidence of fraud against mediums have had their findings flung in their teeth, the retort being always that the bare facts are correct, but that the fraud which they imply was committed by the investigators themselves.

I am not drawing upon a disordered imagination when I say that we shall be exposed to this charge, it has already been made, from several quarters. Those who make it, of course, labor under the disadvantage of not having all the facts in their possession, and hence they are apt to single out as their culprit some one of the sitters who never handled the cards, and hence never had opportunity to substitute. But what is a little detail like that, when there is a medium to defend against charges? What matters it to these people that the substituter would have had to be in league with the medium, in order to synchronise his work with her very dramatic behavior at the critical moment? What matters anything, save that another medium has been discredited and must be rehabilitated?

The SCIENTIFIC AMERICAN had anticipated this defense, however, and had done what we could to meet it in advance. In the most celebrated case where the charge of fraud was turned against the investigators, much was made of the fact, duly established, that a number of people in the confidence of the Committee had had more or less free access to the documents. We decided to avoid this error, at least. Accordingly, at no time before or during the seances were any of the cards out of my immediate possession, save when some of them were sent out to be trimmed, when the medium was actually working with them, and when once or twice she herself handed them to Dr. Carrington to be examined, rather than to me. The latter action was entirely outside the agreed-upon procedure, and could not have been an-

ticipated hence, could not have been taken advantage of. I can, therefore, state without reserve that if substitution were practiced by anybody other than the medium it was I and I alone who had the opportunity. That I did have the opportunity goes without saying: the cards were entirely in my custody between and after the seances. We feel that in thus narrowing the possibilities of fraud on our own part, we met the issue more effectively than by any effort to surround the cards with a system of checking up designed to prevent any tampering with them. It should be simpler to establish that I did not tamper with them than to establish the effectiveness of any such system. It will now be clear why the first person singular has been employed throughout this narrative to such an otherwise indefensible extent and why the story revolves so largely about my own movements. Incidentally if anybody is prepared to believe that I did fake the cards in any way I don't see that there is anything I can do about it and I am very certain that there is nothing I want to do about it. I simply present the issue here so that there can be no mistake about it. The cards were substituted and if the medium didn't do this, necessarily it was I who did.

Our Committee is under no uncertainty as to who did it and I can conclude this story no better than by quoting the findings of the sub-Committee which examined Mrs. Y's mediumship. This sub-Committee consisting of Drs. Prince and Carrington reports:

Mrs. Y came before the Committee to produce independent writing on cards supplied by the Committee. This she has failed to do. All writings obtained have been on cards brought into the seance by her and substituted by her for the Committee's cards. The Committee therefore rules that she has produced no genuine objective psychic phenomena and that her claims to their further attention and to the SCIENTIFIC AMERICAN award stand vacated.

Making Sport a Science

(Continued from page 398)

punch of any given power chosen by himself. The observer determines the power of the punch from the reading of a pointer connected with a spiral spring, after which the candidate is expected to perform further punches with as nearly as possible the same intensity, differences between readings indicating the degree of uniformity.

Still another apparatus, which is shown in our lower right hand corner, investigates the sense of touch and rhythm in the case of oarsmen. The observer seated to the right indicates by means of a key a given rhythm which the candidate is asked to imitate or retain as far as possible. The two series of readings, that of the observer and candidate respectively, are recorded on a drum so as to enable any divergencies to be exactly determined.

Our lower left hand view shows the experimental arrangement for testing will power in connection with sporting activities, individual courage being the particular quality studied. The candidate is asked to hold in his hand a metal ball into which the experimenter is able unawares to pour hot water. Persons easily frightened and devoid of energy and courage let go most rapidly with all the symptoms of extreme fright. The apparatus is arranged for locking partly or entirely the supply of hot water to the ball so that it may be kept cold or lukewarm as desired.

The Science of Distribution

(Continued from page 404)

was well based, but as affecting whole industries, the opposite was the rule.

One striking observation about profits as shown by the Commission's figures is that, generally speaking, they follow the trend of the price of raw materials in an inverse ratio. When the farmer gets high prices for his corn the profit of the corn flakes manufacturer is low; when the farmer sells cheaply, profits to the manufacturer of finished products increases. This appears to be so because such items as cost of manufacture, selling, transportation, overhead, taxes and the like, which enter in the final selling price of an article are pretty well fixed. These costs have shown a steady upward trend (especially taxes, transportation and the cost of manufacture), and to a certain extent are beyond control. The great army of men and women engaged in the business of manufacture, distribution and selling are assured a fairly constant return for effort invested, while the farmer, who contributes

most of the real value of the product, engages in a desperate sort of gamble in values, in which he is often loser.

The fact is, we have outgrown our whole system. We are still doing business by the methods of our grandfathers—the system of barter. This worked fairly well when dealings were between individuals, but today these methods are wasteful and extravagant.

In many instances, also, the machinery for handling agricultural products is woefully inadequate. The Commission found, for instance, that the wholesale district in Chicago was crowded into one narrow street and located without any regard to railroad and shipping terminals. It frequently happened that goods were laboriously carted to this wholesale market from a railroad terminal, sold, and then carted back over the same route and reshipped on the same line. Of course, the consumer paid for this. Happily, this district is now being abolished.

In New York, however, is a situation hardly any better, and with little or no hope for immediate improvement. Few railroads have terminal facilities in the actual city and most of the farm produce which comes in is brought to the docks by lighter and sold at auction on the docks. Out of this have grown some strange practices, which to the layman seem almost inexplainable. For instance, boxed apples, to reach the most favorable market, must have New York Central delivery, while barreled apples must come in by the Erie. One result is that if a buyer wishes both boxed and barreled apples he has to buy at two docks some distance apart and pay two delivery charges.

Such a condition of affairs, it would appear, is not exceptional the country over. A few large cities have taken steps to modernise their marketing and distribution facilities, but outgrown methods still add millions to our bill for necessities.

Another evil which the Commission finds of great importance is the growing tendency on the part of manufacturers of food and other products to extend the scope of their activities beyond the field of manufacture and to engage in distribution. A few years ago the manufacturer dealt only with the wholesaler, who attended to the distribution of his products. Today the manufacturer deals directly with the public, with the result that economy in distribution is forgotten. The aim is rather to secure as *large* a distribution as possible.

The famous orchards of the East, which once furnished most of our fruit, have been neglected and have fallen into disuse, because Western fruit growers have been more energetic in creating a market for their product. Western apples are preferred in New Jersey to the home product although Jersey apples are far superior in flavor. California prunes are sold in Oregon, where better prunes are grown, because of well advertised excellencies, and Oregon prunes are sold in California for the same reason. It is one of the strange phenomena of this age of advertising that products which have been carted half way around the world are often preferred to better ones which may be had right at hand.

We might go on almost indefinitely pointing out specifically just what is wrong with our system of distribution. The truth is that many things are wrong. Some of them are so obviously wrong that they will undoubtedly be corrected. But the whole picture presented by this report is that of a mad scramble for materials and markets in which many groups, some of which have opposite interests, are engaged. It is a case of every man for himself and charge it to the consumer.

Plainly, some directing influence is needed, but it is also quite plain that the whole system is in such a state of experimentation that it would be difficult to say just what ought or ought not be done. Many of our newest institutions for distribution, although they have achieved great financial success, apparently are chiefly valuable as experiments. Department stores, chain stores, city markets, cooperative markets and like institutions each have points of merit, but their effect on the problem of efficient distribution as a whole is doubtful.

Department stores, for instance, undoubtedly effect great economy by the grouping of many stores under one roof and one management. But the very size of the institution makes it necessary to draw its custom from a wide territory. The expense of advertising to draw this widely scattered trade, and the expense of serving these customers pretty nearly balance the advantage gained.

The chain store has gone to the other extreme and has scattered a number of individual stores throughout the territory served and has cut out all but the most essential services. It is found that no really great economy in operation of the individual stores is obtained, excepting at the expense of service. An interesting development in the chain store idea, however, is the growing tendency on the part of the operators of such stores to assume the rôles of manufacturer, wholesaler and jobber. More and more they are engaging in the manufacture of their own goods, selling under their own trademark. If this idea is carried to its logical conclusion, it may have an important effect.

The chief defect in the retail store, it appears, is that there are too many of them. There is a grocery store in this country for every 72.6 families. This leads to expensive competition between rival stores in the matter of service, furnishings, etc., and is the direct cause of a frightfully large percentage of failures among grocers. The grocery is an extreme example of this evil, but other lines are overcrowded, also. For every 602.7 families there is a men's furnishings store, for every 171.6 families a shoe store, for every 691.5 families a dry goods store, and for every 657.5 families a hardware store.

When it is considered that the larger stores each serve thousands of families, it is difficult to see how the smaller stores can subsist on the patronage left to them. As a matter of fact, they don't subsist, hundreds of failures annually help to widen the gap between producer and consumer. For the loss occasioned by every failure somebody must pay—and you may be sure it isn't anybody who is able to pass the charge along. The consumer pays, here as always.

The municipal market has been widely heralded as the instrument which would finally bring the producer and consumer together on common ground, eliminating all of the middlemen and allowing both parties to profit by their mutual exchange. From the standpoint of both producer and consumer the city market is a failure. The producer usually does not care to turn retailer, and when he does, he demands a premium over market price for his goods because they are "fresh from the farm." The truth is that in nearly every city where there are municipal market places, the stands are occupied, not by farmers, but by speculators, either openly or through some subterfuge. The final argument against the city market is that, even if the idea were practical, and all of the available gardening space within hauling radius of our large cities was intensively cultivated to supply these markets, they could supply only a fraction of the foodstuffs consumed in these cities. New York City is unusually well situated as to the proximity of great areas suitable for gardening, and yet it would be possible to raise only about five per cent of the vegetables used in the city on this land. As a matter of fact, the portion of the city's vegetables and food which comes from this source is a negligible portion of one per cent.

The Commission considers that one of the really promising experiments looking toward the more efficient distribution of essential commodities is the farmers' cooperative movement which is sweeping the country. A whole chapter of the report is devoted to this topic. Statistics compiled by the Bureau of the Census show that in 1919, $721,983,680 worth of farm products were sold through cooperative organisations of farmers and that 7.9 per cent of all the farms in the country made sales through such organisations. Purchases through the same organisations in 1919 were $84,615,669. No accurate figures are available since that date, but it is safe to say these probably have been more than doubled since then.

The chief hope in these organisations is that they are centralising, taking over functions of distribution which heretofore have been intrusted to speculators. They sort and grade their products before sending them to market and thus are making long strides toward standardisation of farm products. By owning or controlling storage facilities they prevent dumping of large quantities of a product on the market at one time, a practise to be commended because it assures the farmer a fairer price, saves the consumer from extremely high prices by spreading out over the year the process of distribution, and takes away one of the chief assets of the gambler in foods.

The conclusions drawn in the report are general, rather than specific, as we have suggested. The chief value of the document lies, however, not in the conclusions, but in the facts which it presents. It has given us something to think about, and, for the first time, a sound basis for action.

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Lack of space makes it impossible to give many cross-references, or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case the general subject should be sought, rather than the supposed specific title of an article; the article may not be indexed under its specific title at all, but may be entered under a statement of what it is about, so that it may the more readily be found by one seeking references to its subject matter. We call special attention to the classifications Household Appliances, Machines and Machine Tools, Machines for Special Purposes, Tools, etc., under which many items will be found whose location otherwise would be very puzzling. These groups may be examined item by item for a doubtful entry with much greater ease than can the entire alphabet. The individual articles on the chemistry and motor truck pages are indexed separately; the short notes comprising the columns of text on the advertising pages appear only under their column headings. The asterisk (*) indicates that the article in question is illustrated.

Armor Mats for the Protection of Bank Vaults

IN these days of coined names to identify certain products, the technical writer must needs proceed cautiously lest he give some convenient word or combination of words to an ordinary product only to discover that he has used a registered trade-mark in vain A case in point appeared in our October issue, in an article entitled "Protecting Our Great Banks" Therein is a photograph bearing the caption "A 30-inch thick block of steelcrete (concrete and steel) after a laboratory attack lasting only a few minutes, made with modern tools."

Now the truth of the matter is that the caption writer should not have used the word "Steelcrete' in referring to the reinforced concrete block shown in this instance STEELCRETE' is a registered trade-mark for a product used for the purpose of reinforcing concrete and for building up "Steelcrete" Armor Mats which are used for the protection of bank vaults. Of course, the name 'Steelcrete' was used to signify the usual form of reinforced concrete, without knowledge that such a coined word was a registered trade-mark applying to a definite product. We are very sorry that this error should have occurred.

We are informed by the manufacturers of that product, as well as by affidavit of tests, that it is utterly beyond the scope of any modern implement to cut a man hole in any properly built concrete wall 30 inches in thickness in a few minutes time, much less a concrete wall containing a 'Steelcrete" Armor Mat which type of wall has been pronounced by Government tests to be the strongest and most non penetrable of all practical forms of vault wall construction

The great vault in the new building of the Federal Reserve Bank now under construction in New York is protected with "Steelcrete" to the exclusion of the heavy steel laminated metallic plates which have been heretofore used for vault protection. The Bowery Bank vault at 42nd Street, as well as the vault of the Greenwich Savings Bank, Herald Square, are also protected with "Steelcrete."

Our Abrams Investigation—III

(Continued from page 392)

Two main reasons have been given for Dr. X's failure, aside from the fact that his equipment or technique may be at fault, according to many of our correspondents. First, our test, having for its object the differentiation of various pure germ cultures, submitted in vials with labels bearing numbers corresponding to those of a list kept in our possession, was quite unfair This is news to us. We were assured that the test was quite elementary and certainly the starting point in an investigation having to do with such an involved and amazing technique. Our first move was, and still is, to determine whether germs can be detected and properly tagged by means of a battery of rheostats, a simple wiring arrangement, a human "detector" or reagent, and the skilled electronic practitioner If we could have such a demonstration to our complete satisfaction, then we could go on to the analysis of the more intricate blood sample. The test seemed fair in advance, and was admitted as fair by Dr X and his staff. The claim that it is unfair is apparently an afterthought, advanced in the light of the total failure recorded. We cannot permit such untimely alibis in a scientific investigation, else we shall never reach an undisputed conclusion. We discuss this 'alibi" more strictly on its merits below

The second reason given for Dr X's failure was the faulty performance of the reagent, in an electronic reactions sense. We shall come back to this phase presently

To discuss the first point, it has been pointed out to us that no electronic diagnostician has ever undertaken a test of this exact nature. That may be so, precisely considered, but we do know that Dr Abrams supplies small vials containing various germ cultures which are employed for testing the electronic equipment However, our pure germ cultures, we have been told, were entirely too powerful for the sensitive electronic reactions. The radioactive emanations from these samples were so powerful that they "slopped over" or overran all the different 'rates", or wavelengths, if we may use that term for convenience, of the diagnostic equipment. Otherwise expressed, the powerful emanations of the pure germ cultures are out of all keeping with the usual weak emanations of a drop of blood, and it is for the latter situation that the apparatus and technique are designed.

Assuming that these comments are based on fact, then we had a most unfortunate situation for the diagnostician The pure germ cultures gave out such powerful emanations that their respective "rates" were no longer sharply definable, but overrun or "slopped over" the entire scale of "rates." Thus the diagnostician got reactions for almost everything, as was reported in our November issue. We have a suitable analogy in the case of a receiving set located alongside a powerful spark transmitter The transmitter may be tuned to 500-meter wave length. The operator of the receiver desires to pick up distant stations of other wave lengths. Yet, no matter how he tunes his receiver, he still gets the 500-meter wave length of the nearby transmitter, and not the weak signals from the distant stations. Powerful radio signals are difficult to tune out, at times.

This explanation for Dr X's failure sounds logical, as far as it goes. We have still to learn more about the electronic reactions and the relative strength of blood samples and germ cultures before we can pass judgment on this explanation That the electronic workers mean what they say, we have evidence in the request of another doctor to undergo the same test, with certain modifications. This doctor states that he undertook his own test with pure germ cultures after hearing of our test with Dr. X, and that he had unsatisfactory results. Now he desires to have the pure germ culture vials sheathed with lead, so as to reduce the radioactive emanations, and in this way he believes that it will be possible to reduce the powerful "kick" of the cultures so as to confine them to their respective "rates." It may require several tests to obtain satisfactory readings from the rheostats, since we are dealing with an unusual series of circumstances, so we are told, but the averages from several tests ought to give a determinative result.

The second reason for Dr X's failure is the faulty performance of the reagent, due to the severe strains imposed by the powerful radioactive emanations of the pure germ cultures. We have been told that reagents are a most variable factor in electronic diagnosis—in truth, it is hoped that the time is not far distant when the reagent's delicate nerves, which give the reactions, may be dispensed with in favor of some mechanical or electrical device.

At any rate, George, the reagent employed by Dr X in our test, may have been rapidly exhausted by the severe strain of the powerful emanations. Thus, after a few moments his reactions were quite unreliable and therefore worthless. To this suggestion we can only reply that George, on several occasions during our long session, was asked to "short" himself, which he did, and the reactions returned to normal in every instance, indicating to Dr X's satisfaction that the reagent was still performing satisfactorily. Hence this second reason for Dr. X's failure, which has been advanced by several of our correspondents, is readily disposed of.

The entire electronic reactions matter is an intricate case of wheels within wheels. Our plan of investigation for the present is to learn, first of all, the ability of the electronic diagnostician to differentiate various pure germ cultures, which may be suitably diluted or sheathed or otherwise treated to meet electronic requirements. Then we shall go on to blood samples, checking up the diagnoses with clinical reports. We hope to have diagnoses made of handwriting samples, although we fully appreciate that this phase of electronic work is merely an interesting experiment. Having established what the technique is capable of doing, we shall pass on to a study of the equipment involved and the underlying principles. Perhaps we shall examine the electronic treatment, although for the present the diagnostic feature is a sufficient problem and is more readily susceptible to the routine procedure of scientific investigation.

Worn Out—Just rubbed in air

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Just rubbing the atmosphere kindles the blazing ball you see, the "shooting star" The friction of just moving through the air is what utterly consumes it

Anything which moves, however fast or slowly, even in the thin invisible air, or on finest lubricating oils is inevitably subject to the wear of *motion*

It is motion, as you know, which wears your motor car How long your automobile will last, how smooth running and quiet you can keep it depends then upon how well you are permitted to compensate for the wear that *must* follow motion

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